

**EXTRA** PAGES **EXTRA** FEATURES **EXTRA** PICTURES

# POPULAR SCIENCE

35<sup>c</sup>

JUNE

Monthly

**Double-Length  
Feature:**

## **WORLD'S RECORD SHIP SALVAGE**

PAGE 235

**A True Science Adventure**

**The Truth About Spark Plugs**

PAGE 43



"SKIMOTORS" FROM GALE...

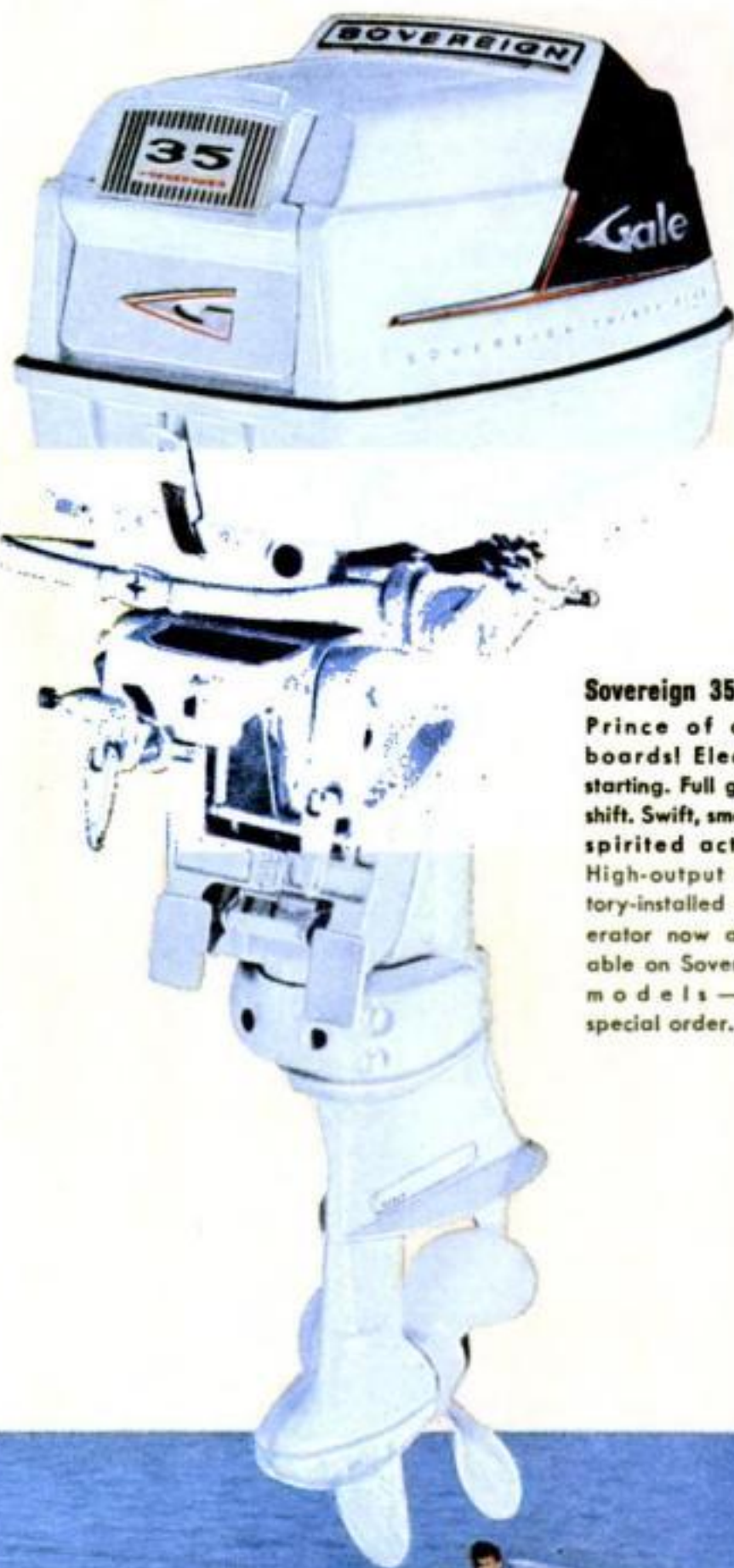
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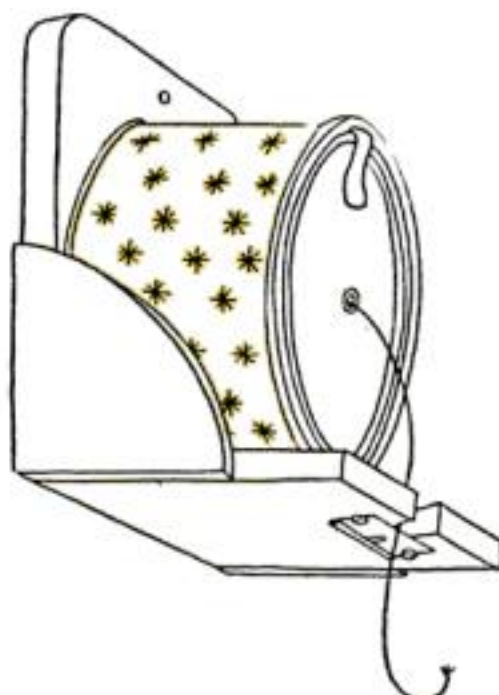
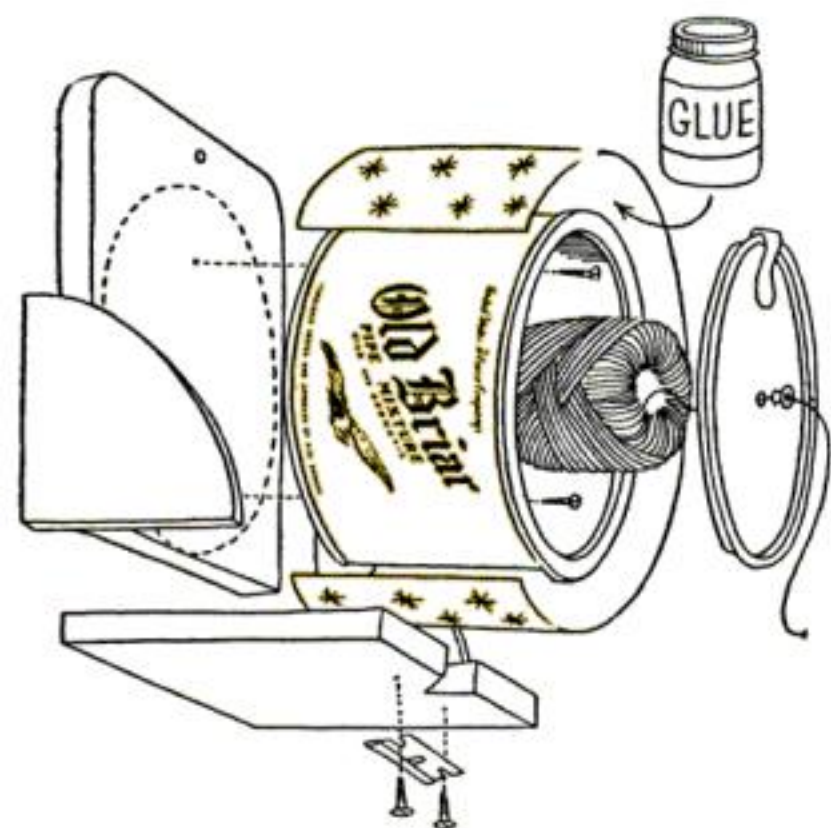
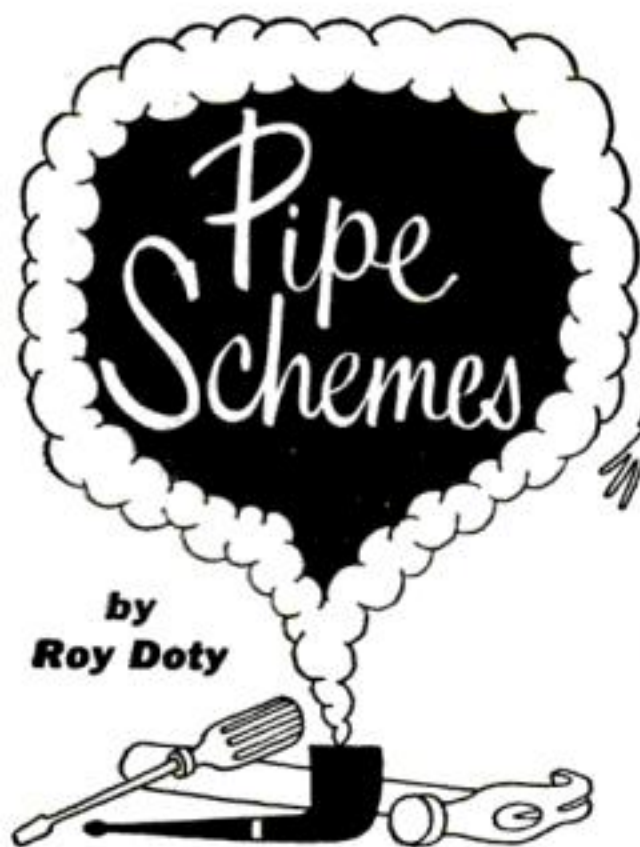


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**Torture:** Cop cars must be able to take it. *P. 75*

**Plot:** That night, a frightful crime was prevented. *P. 52*

**Kitchy-Koo:** Baby Gorilla chortles at tickle time. *P. 82*

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# Popular Science

**June, 1960**

Cover photo by Robert D. Borst

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**Hailstones:** Science can only measure 'em. P. 88



**666 Feet Down:** His lookout point was a steel boiler. P. 235



**Kinderwagen:** Get off, Dad! This one's for the kids. P. 113

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# PS Readers

## TALK BACK



### Spaceniks Too Normal

I WAS most interested to see George Price's article ["U.S. Begins Search for Beings in Other Worlds," Apr.] since it included my remarks on extra-terrestrial life.

A few words on the drawings: Even though the forms (barring the girl) are most bizarre looking, all but the plant-animals (which I had previously said are not biologically credible) are far too human-like, or at least too vertebrate-like, to illustrate *my* ideas of extra-terrestrial life. They have the typical pattern of a head with ears behind, eyes above, then nose, then mouth below it, that is found only in vertebrates and that is likely to have been very seldom repeated in forms that have developed independently, even if they are intelligent.

H. J. MULLER

Indiana University, Bloomington.

### PS Gets Award-Winning Habit

It is my pleasure to inform you that your organization has been voted the National Safety Council's Public Interest Award for 1959.

We here at the Council know all you have been doing for safety, and we are delighted that the judges agreed. I am sure you feel, as we do, that there is another dividend as a result of your safety efforts—the knowledge that you have helped prevent many accidents.

HOWARD PYLE, PRES.

National Safety Council, Chicago.

*This makes it 10 years in a row.*

### Rotary Engine Stuffs Mailbag

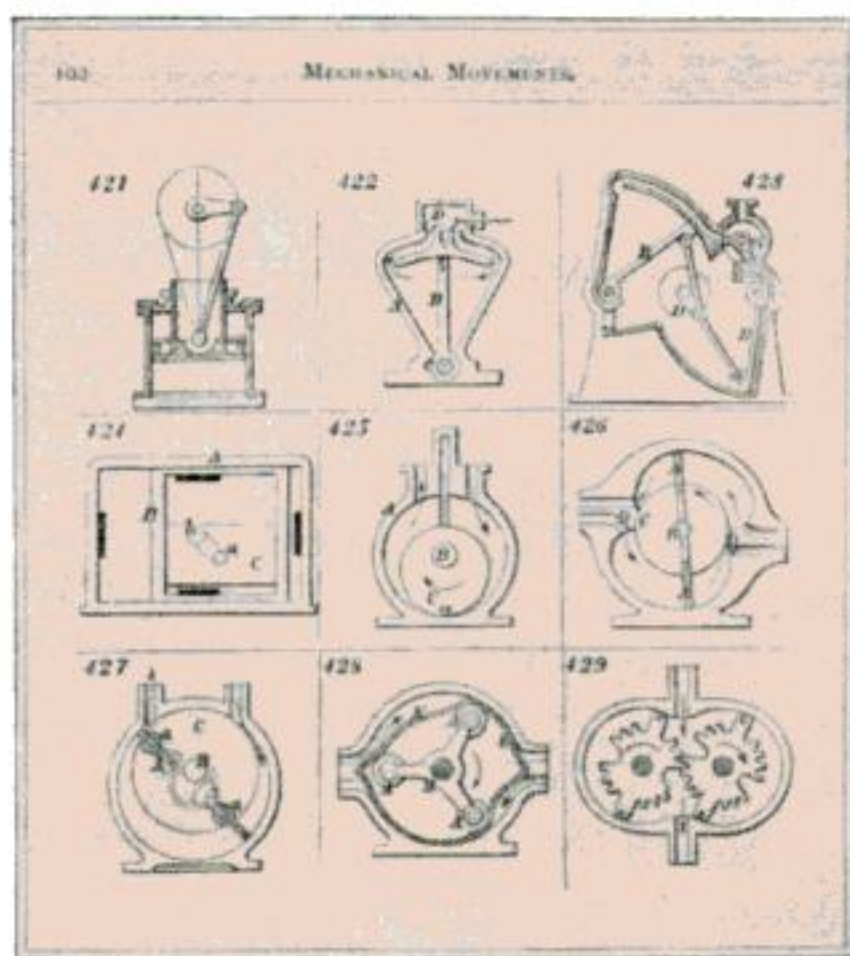
AFTER reading "Auto Engine without Pistons" [Mar.], I must disagree on one point: that it takes energy to start and stop a piston in a conventional engine.

It takes energy to start it. But, except for frictional losses, the energy recovered while decelerating the reciprocating masses is just what was required to accelerate them in the first place. There is, therefore, no net energy required to accelerate and decelerate pistons.

C. A. RAMBOW, Waunakee, Wis.

*If you assume an ideal engine—no friction, perfect elasticity of all parts—you're right. Reversing the direction of motion introduces no losses. But in actual reciprocating engines there are losses.*

... MAY I refer you to the book *507 Mechanical Movements* by Henry Brown? Published in 1881, it shows an identical



rotary engine—invented 80 years ago.

N. W. DAVIS JR., Poughkeepsie, N.Y.

*None of these is really very close to the NSU rotary—and all are designed for steam, not as internal-combustion engines.*

... SEVERAL technical writers are hanging by the thumbs for redesigning Felix Wankel's engine. Cut your man down so he can read my thoughts:

First the cover drawing. The gear on the shaft doesn't belong there. It's a shal-



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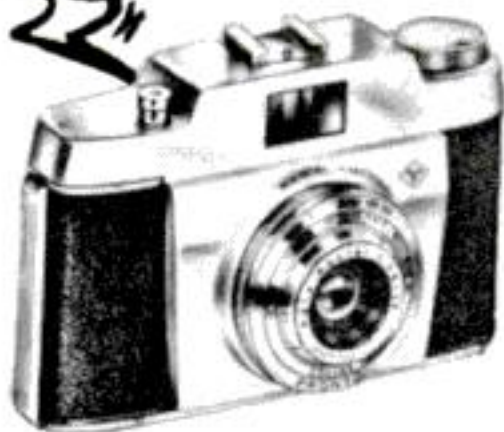
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low gear about  $\frac{3}{8}$ " thick and is mounted on the rear cover, concentric with the bearing hole for the shaft. And it's stationary.

As for the article, it leaves the shaft unexplained. It has an eccentric the same size as the hole in the rotor. As the rotor turns, it rotates on the eccentric shaft and also turns the shaft.

FRED SEEMAN, Elmhurst, N.Y.

Several readers deduced what you describe. At the time the material was supplied us for the article, this information was not released.

. . . A SIMILAR engine was invented back in the Thirties by George Stewart, a law clerk for the U.S. House of Representatives, Washington, D.C. I saw his "segment" engine run 25 years ago.

E. B. KLOPPER, Washington, D.C.

. . . You say the operation of the pistonless engine "is standard four-cycle although there are three power 'strokes' for each revolution."

I'd say the engine seems better described as two-cycle: a) There is a combustion process every revolution for each of the three charge cavities, not every other revolution as in four-cycle engines. b) The effectiveness of a portion of the compression-and-expansion processes is lost while inlet and exhaust ports are open into the charge cavity. This has a direct counterpart in two-cycle engines.

J. H. PEEBLES JR., Harahan, La.

Its sequence of operation is exactly like a four-cycle engine. Yet it is exactly like a two-stroke machine in that you get one power stroke for every revolution of the shaft. Actually the rotary is neither four-cycle nor two because it is not a reciprocating engine. It's a new breed.

## Shabby Hitch

I ENJOYED the quiz in March ["Can You Moor a Boat?"] but I'd like to



match nautical wits with the author.

In the picture labeled Good Seaman-



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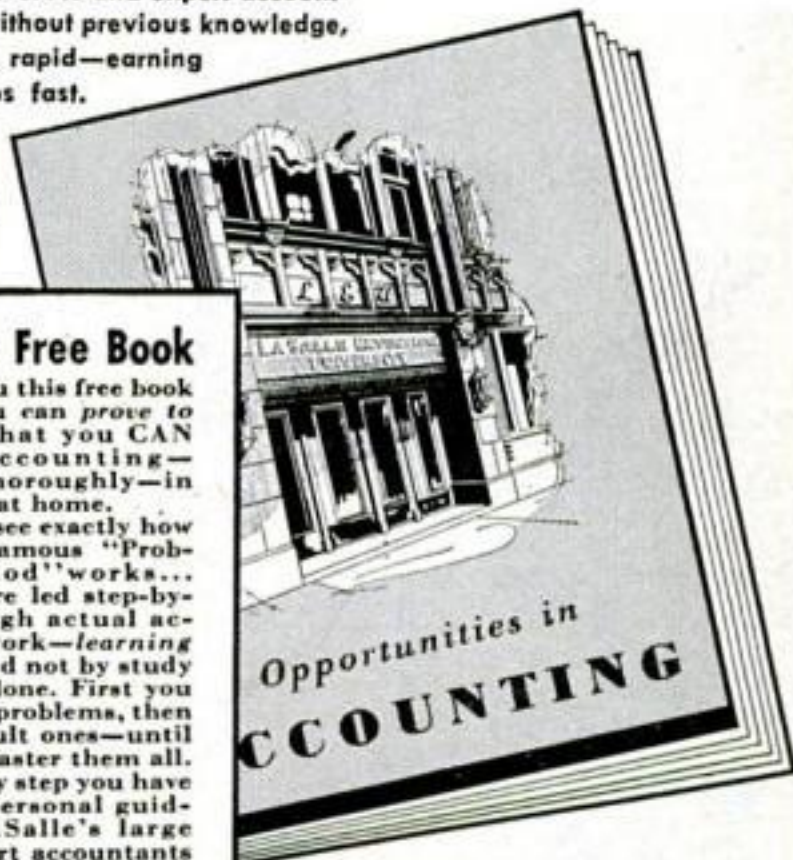


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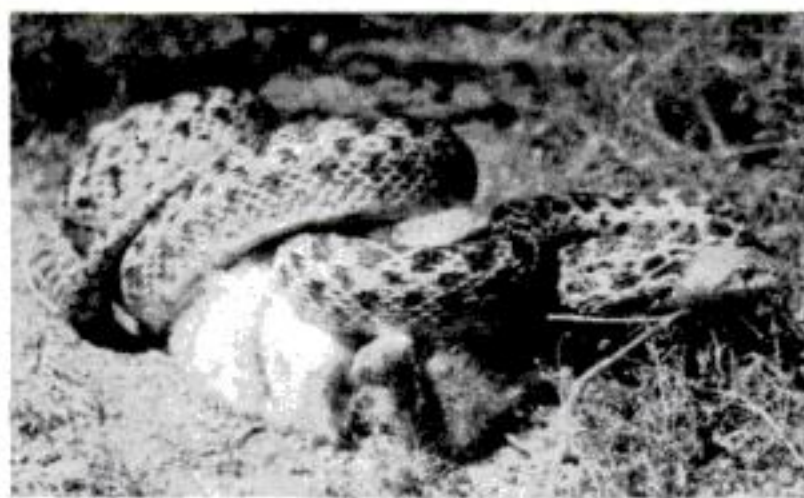
ship he shows the bow of a boat with the bow line neatly stowed. Now that's a mighty shabby hitch he has around the bow cleat. The line that runs over the side should be underneath, not over itself; or, better yet, the hitch should have been started from the other end of the line with the last loop underneath itself.

JAMES ACHESON, Seattle.

## The Kindly Gopher

A SALUTE to Wesley S. Griswold for the most accurate description of a gopher snake ["America's Most Misunderstood Snake," Apr.] I've ever read.

This photo of a five-foot gopher snake trying to throttle a cottontail was taken



just outside my studio. The rabbit was still alive when I snapped it. A five-footer once came right into our kitchen and my wife just eased it out with a broom.

HI SIBLEY, Nuevo, Calif.

## New Vanguard a Rearguard?

I WOULD strongly advise the Chrysler people to check with Standard Motors of England before naming their new compact Dodge the "Vanguard." Otherwise they may run into a lawsuit.

Standard Motors has been producing a sedan of that name for years and has been selling them in Canada since 1949, although I don't believe it is sold in the U.S.

They're now styled in Italy and can be had in automatic models, for the fumble-fingered. As you've probably guessed, I drive a Vanguard.

WILSON PRICE, Quebec, P.Q.

## Front Drive Vs. Rear Drive

"ARE U.S. Front-Drive Cars Coming?" [Feb.] was interesting. But with a toy friction-powered car, one can prove the loss of traction you'll get in such cars.

With its motor turning, place the car on a slanted surface—first with the drive





TRIPLE EXPOSURE at f/11 is how our Speed Graphic caught this fellow flexing his muscles. Just try this exercise yourself. See how fast you heat up, tire out. When you do, remember that your *tires* do 700 "knee bends" per mile as they roll along under your car.



Too much flexing wears out people  
...and ordinary tires! But not

## THE TIRE THAT DOESN'T GET TIRED

New *Low Profile*\* tire is actually made  
lower and wider so it flexes less,  
lasts longer.

Excessive flexing is what wears out, burns out tires, weakens rubber and fabric, increases blowout danger. And ordinary tires do flex excessively.

But U.S. Royal has pioneered a new "Low Profile" shape tire that *flexes less, runs cooler, lasts longer*. It offers new protection against high-speed failure and heat blowouts.

Other tire designs don't give such thorough protection. Yet "Low Profile" tires cost no more than ordinary tires. So don't run the risk of tire failure. See the *complete* line of U.S. Royal "Low Profile" tires—now in 5 popular price ranges for every make and model car—at your U.S. Royal Dealer.



Same air pressure...but look at the difference

Excessive flexing pushes the temperature of ordinary tires above 240° F. That's the danger mark. But the lower, *wider* shape of U.S. Royal "Low Profile" tires reduces flex, keeps tires *cooler*, even at top highway speeds.

\*"Low Profile" is United States Rubber Company's trademark for its lower, wider shape tire.

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# U.S. ROYAL *LOW PROFILE*\* TIRES



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wheels forward, then with the drive wheels in the rear. With the drive wheels up front, the car shudders and slowly moves up; but with the drive wheels in the rear, the car moves instantly.

J. P. JARRELL, Montgomery, Ala.

### Grocery Bags Are for Garbage

ONE of your Short Cuts and Tips [Feb., p. 152] tells how to make replacement bags for vacuum cleaners out of grocery sacks.

Grocery bags cannot be used for filter bags on vacuum cleaners because they are not sufficiently porous. Air must pass



freely through the bag. Otherwise, the resulting back pressure would reduce the nozzle suction to almost zero. Much research effort has been spent during the

past 15-20 years by Hoover as well as other manufacturers in developing disposable-type bag materials that would satisfactorily trap the dirt, and at the same time offer a very minimum amount of resistance to air flow.

L. K. ACHESON

The Hoover Co., N. Canton, Ohio.

### Blueprint Makes a Hit

I SURE liked the March magazine because of the blueprint for making a ball-turning attachment for a lathe. For hobbyists like me, the blueprint idea points in the right direction.

L. M. SMITH, Stow, Mass.

### Rambler Man

WHY not give equal time, space, and tests to the best-for-the-money U.S. car built—the Rambler American?

I owned a '59 two-door, my 13th car in 14 years, and it was the most satisfactory of the lot. Give it the same tests you gave the Falcon, Corvair, and Valiant, and you'll find it rides better, gives consistently better gas mileage, parks, drives, and handles better generally. On

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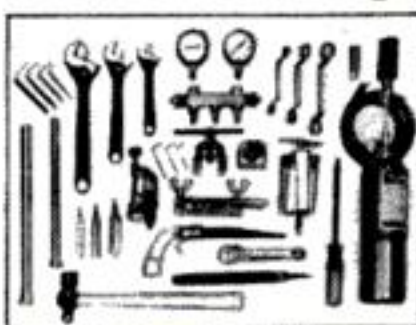
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the highway it can show its heels to the other three.

On a 3,000-mile trip last summer with four people, we averaged a little better than 29 m.p.g., used no oil, and developed no squeaks, rattles, or groans of any kind. I've worked as an auto mechanic for 18 years and I've never known a more trouble-free car.

J. P. KESLER, Louisville, Ky.

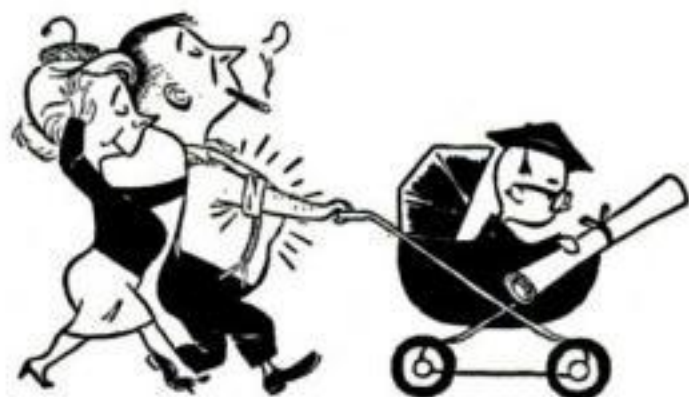
### Science Not for PS?

IN ADVOCATING the breeding of supermen ["The Month in Science," Mar.], Indiana University's Hermann J. Muller is no better than Adolf Hitler. Hitler failed in building a "super race," but he still caused an awful lot of human misery in the world.

Oh sure, Muller's idea is altogether different. He wants to turn out "carbon-copy geniuses"—with a third eye that works backwards, maybe?

R. H. FANNING, APO, NYC.

... IT AMAZES me to see the depths to which an allegedly learned man can fall when discussing a topic outside the narrow world of science. If Muller truly wants to better this world, he should



start, not with improving people physically and intellectually, but by building up their humanity.

His ideas are fine for chickens and rabbits, but completely unsuited to human application on any large scale. Let him stick to his test tubes and leave human problems to humane minds.

HARVEY STEINFELD, NYC.

*That's what Muller says he has in mind: "to upgrade the tired old human race into a world-wide family of paragons—upright, loyal, tolerant, kindly."*

### The End That Stings

VERY interesting article on spiders ["How Deadly is the Black Widow?" Mar.], but one glaring misstatement. On

CONTINUED



## WHAT THE HECK IS A "MOTOR MINDER"?

Technically speaking, it is a special kind of vacuum gauge, but to the man who knows engines it's a great deal more. It tells you more about what is going on inside your engine than any other instrument on your dash.

A Stewart-Warner Motor Minder alerts you in time to these five types of common engine troubles: (1) Bad valve timing (2) Leaking valves (3) Improper ignition timing (4) Obstructed exhaust system (5) Defective spark plugs and points.

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### VITAMIN B<sub>1</sub>

25MG.	50MG.	100MG.
250 for... \$1.00	100 for... 70¢	100 for... \$1.00
1,000 for... \$3.25	250 for... \$1.50	250 for... \$2.25
	1,000 for... \$5.25	1,000 for... \$8.00

### VITAMIN C

100MG.	250MG.	500MG.
250 for... 95¢	100 for... 80¢	100 for... \$1.35
1,000 for... \$3.00	250 for... \$1.85	250 for... \$3.15
	1,000 for... \$6.50	1,000 for... \$10.75

### "RED" VIT. B<sub>12</sub>

25MCG.
100 for... 90¢
250 for... \$2.10
1,000 for... \$7.25

50MCG.
100 for... \$1.60
250 for... \$3.75
1,000 for... \$13.50

### VITAMIN E

50 INT'L UNITS	100 INT'L UNITS	200 INT'L UNITS
100 for... \$1.65	100 for... \$2.15	100 for... \$4.00
250 for... \$3.75	250 for... \$5.00	250 for... \$9.50
1,000 for... \$13.00	1,000 for... \$18.00	1,000 for... \$35.00

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Vit. B <sub>1</sub> 3 Mg.	Cal. Panto 5 Mg.
Vit. B <sub>2</sub> 3 Mg.	Vit. E 1 Int'l U.
Vit. B <sub>6</sub> 0.75 Mg.	Folic Acid 0.34 Mg.
Vit. B <sub>12</sub> 5 Mcg.	
	Phosphorus 15 Mg.
	Copper 1 Mg.
	Iron 13.4 Mg.
	Magnesium 7.5 Mg.
	Iodine 0.1 Mg.
	Manganese 1.5 Mg.
	Potassium 5 Mg.
	Zinc 1.4 Mg.

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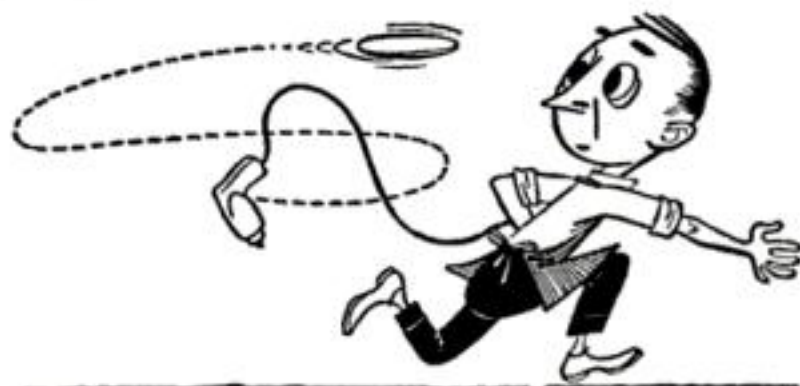
page 231 you ask, "What if you're bitten  
by a number at once—as you might be  
by a swarm of bees?"

Bees never bite people. They sting—  
in self-defense—with the stinger at the  
rear of the body.

THOMAS FUSCALDO, Paterson, N.J.

### Flying Saucer?

I AM not a machinist but I question  
the safety of using a suction cup to hold  
thin work for polishing in a lathe. ["One  
Machinist Tells Another," Feb.]. At very  
low speeds it might be safe enough, but  
what would happen with a lathe at high  
speed, or with an electric drill as the



power supply? The disk could be a very  
dangerous flying object if it became de-  
tached from the suction cup.

F. J. HILLENBRAND, Albuquerque, N.M.

### Ah, Progress!

DON'T know if you've covered this in  
PS (which seems to point its cameras  
everywhere), but it kind of tickled me  
when I read it in the newspaper:

In Damascus, Cairo, and other Mos-  
lem cities, they've modernized the an-  
cient muezzin's call to prayer. It still  
sounds from a minaret of each mosque,  
but now it's broadcast by loudspeakers  
that amplify a recording from a central  
station.

What's more, they estimate that the  
volume is 10 times that of the lustiest  
muezzin's voice.

J. D. OLSON, Washington, D.C.

### Yen for an Electric Buggy

I've read all your articles on electric  
cars, and the one on the electric tractor  
[Feb.]. There are many towns like mine  
where terrain and climate make the idea  
of a small electric runabout most attrac-  
tive. I'd think commuters might be inter-  
ested, too, in such a vehicle for house-  
to-station runs.

I'd like to see PS design an attractive  
do-it-yourself two-seater—one on the or-





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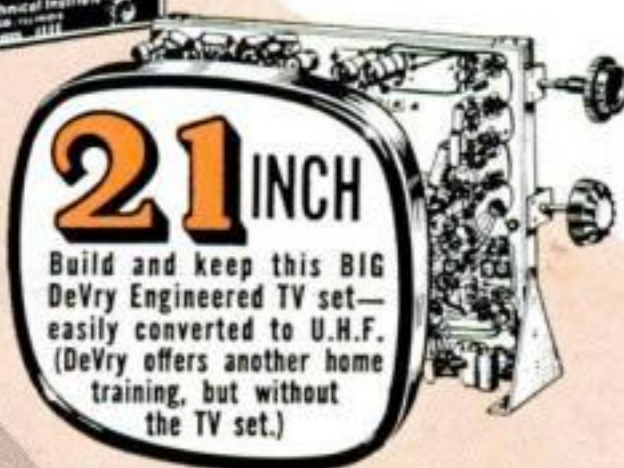
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der of the old curved-dash Oldsmobile—paying great attention to the weight factor, and aiming for a top speed of 30-40 m.p.h. and a 40-50-mile range. With light aluminum or magnesium wire wheels, foam cushions, marine-plywood body, it should be possible to approach this objective.

H. E. KAMBACH, Key West, Fla.

### How to Dig Groundhogs

THERE'S a question I'd like to ask Dr. Lyman ["Nature's Big Sleep," Feb.]. Did he ever dig a groundhog out of its burrow during the winter? I have, many a one.

They don't hibernate in an open burrow. From about Nov. 1 to March 15, their burrows are closed with dirt from about three feet from the entrance to their sleeping place on a bed of dry leaves. There is no opening to the outside.

I have dug them out with a pick and shovel and have got as many as six out of one burrow.

ROSCOE SHIVERS, Kansas City, Kans.

... A REAL brilliant thought came to me while reading the article on hibernation: It would be very convenient if prisoners could be forced into hiberna-



tion on a mountainside or somewhere in Greenland, say. This should save a lot of money and labor. And the prisoners would never grow old!

T. J. MATHEW, Ilaro, W. Nigeria.

### Catapult for Biggest Ship

THE U.S. Atomic Carrier Enterprise ["World's Biggest Ship," Mar.] will not have steam-powered catapults, but will use a new internal-combustion catapult power plant, now waiting at dockside to be installed. Developed by Thiokol's Re-

[Continued on page 40]

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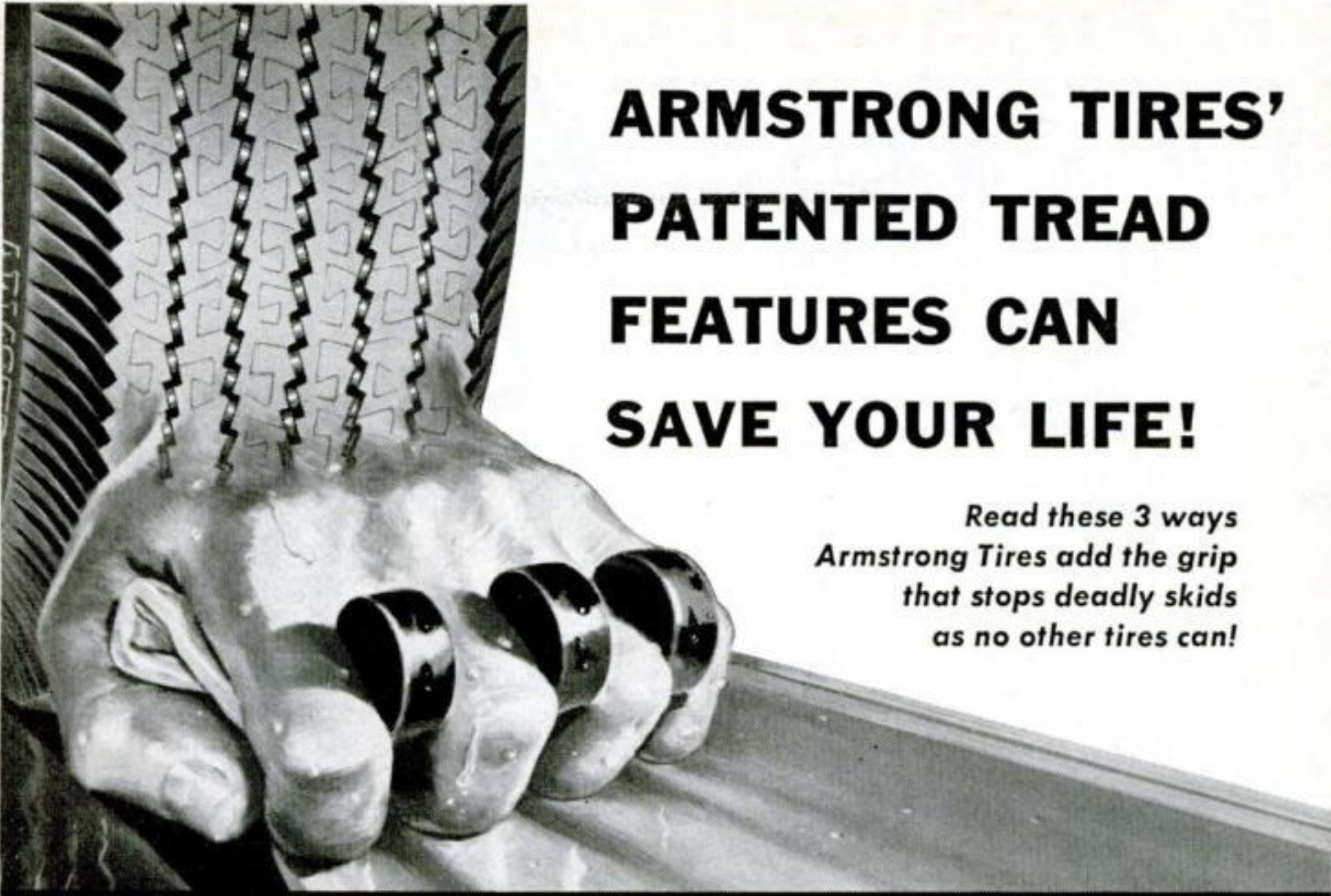
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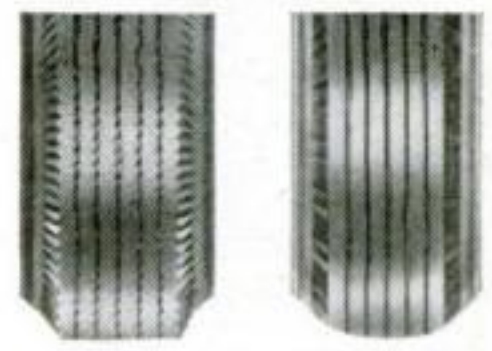
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<p>Famous "Ounce of Prevention"</p> <p><b>PATENTED SAFETY DISCS KEEP TIRE'S GRIPPING EDGES OPEN</b></p> <p>Just as Safety Discs in fist (above left) keep fingers apart, so over 1000 Safety Discs in each Armstrong Tire keep tread's gripping edges apart, always ready to grip — no matter how hard you brake!</p> <p>But fingers of fist <i>without</i> discs (above right) can squeeze shut. That's why ordinary tires, lacking Safety Discs, can squeeze smooth and slippery under braking pressure — <i>and you skid.</i></p>	<p>Grip in all directions!</p> <p><b>PATENTED INTERLOCKING SIPES ADD OVER 2600 GRIPPING EDGES!</b></p> <p>Sipes are slots put in tires to add gripping edges. Only Armstrong tires have S-shaped, <i>interlocking</i> sipes. They add over 2600 gripping edges, provide "bite" in ALL directions, sharply improve protection against forward <i>and</i> side skids.</p> <p>In winter, interlocking sipes' "wiper" action keeps you safer on wet roads, gives you snow tire "go" on packed ice and snow.</p>	<p>Grip where it counts!</p> <p><b>UNI-CUSHION CONTOUR LAYS MORE LIVE RUBBER ON ROAD</b></p> <p>Armstrong Tires, when inflated and rolling, put more tread — more gripping edges — on pavement. Greater stability at high speeds! Faster, surer stops when you brake!</p> <p>Another extra: Armstrong's anti-vibration tread cancels noise! No hum, no drone — you ride on a whisper. And compare Armstrong's ironclad guarantee! See your Armstrong dealer — listed in the Yellow Pages.</p>	

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# PS Puzzlers By Joan Steen

A rendezvous for riddle fans . . . Answers on page 206



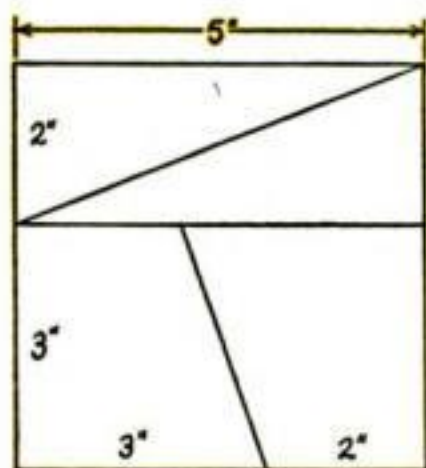
## How to have fun with a parking ticket

EVER wonder if the police have a system for giving parking tickets? I like the story of the Cornell math professor who got 12 tickets for overnight parking. All 12 came on Tuesdays or Thursdays. The professor pondered. Should he rent a garage for those days? Or was it just a coincidence?

This isn't strictly a puzzle, because you

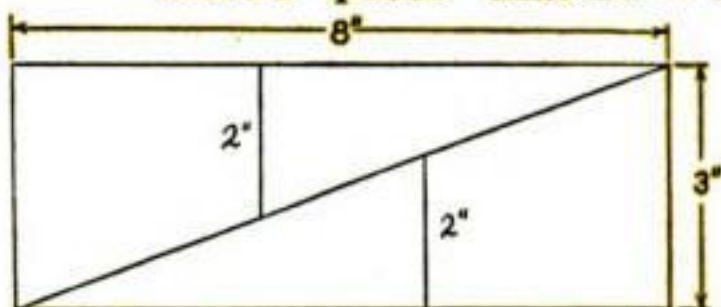
can figure out exactly what the odds are that such a thing could happen by chance alone. Nevertheless, we believe in passing on useful information.

You might also consider this variant: Suppose you got 12 tickets and none of them was given on a Sunday. Would you be safe in assuming the police weren't operating then?

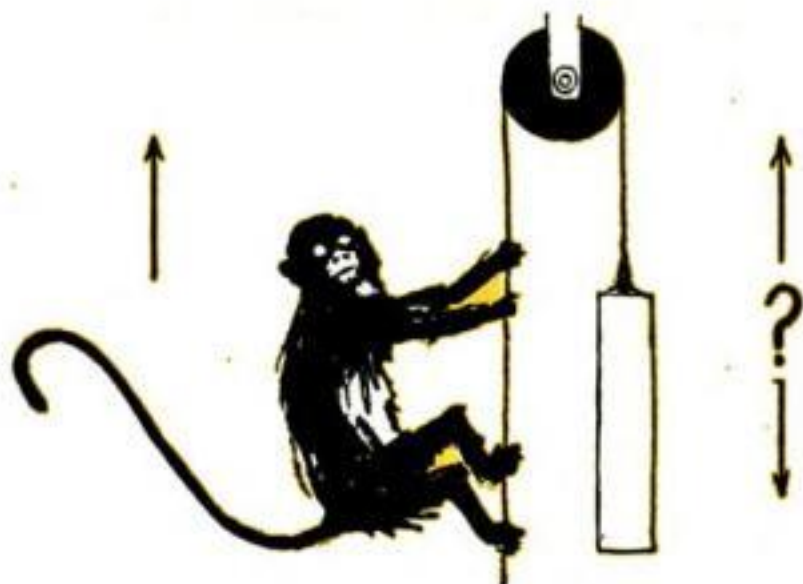


I HAVE a fondness for fallacies. Show me that  $1 = 2$  and I'm amused. (It's only natural for a woman to be given to contradictions.)

Here's "proof" that  $24 = 25$ . Can you spot the flaw?



The area of the square is 25 sq. in. But reassemble the parts to make the rectangle, and the area is only 24 sq. in.



A LITTLE mechanical sense and you can solve this puzzle—and feel real pleased with yourself. It once stumped a convention of puzzle experts.

A whimsical monkey hangs on the end of a freely flexible rope suspended over a frictionless pulley. A weight, balancing the monkey's weight, hangs at the other end. As the monkey starts to climb the rope, what—if anything—happens to the weight?

THEY credit Sir Isaac Newton with making up this rustic problem—no doubt while basking under a tree waiting for that apple to fall.

Three cows ate all the grass on two

acres of land in two weeks, together with whatever new grass grew there in that time.

Two cows munched another two acres of grass in four weeks, plus whatever new



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## PS Puzzlers continued

grass grew up in the four weeks' time.

Confused? Here's the question: How many cows in six weeks' time will eat all the grass on six acres of land, including all new grass that grows in that time?

**T**HE old saying, "It's all done with mirrors," certainly applies to this puzzle. But consider your knuckles rapped should you resort to props to figure it out:

"I saw the bandit in a mirror as he fired," said the man in the barbershop chair. "He was outside the window."

"What was he like?" asked the sheriff. "The only other man who saw him is dead."

"He wore jeans and a khaki shirt. A mask and a hat pulled low hid his face. All I'm sure of is he's a southpaw. He held a gun in his left hand, a paper bag in his right."

"That had the money in it," said the sheriff, glancing at the big mirrors, one in front of the chair, and another on the wall behind it. "But if you saw him

(Assume the usual constants: The grass grows at the same rate; all acres start with the same quantity of grass; all cows have the same appetites.) Hint (sometimes we're generous): First find out how much new grass crops up on one acre in one week's time.



in a mirror, his left hand would have been his right."

"Yeah," the customer said, "but I remember seeing the window sign just over his head. It was backward."

"You sure?" asked the sheriff sharply. "Think hard—it's important."

Was the bandit a southpaw or not?

### Puzzle of the month



**O**F COURSE the shortest distance between two points is a straight line. Hmm . . .

A spider spots a fly across a room 30 feet long, 12 feet wide, and 12 feet high. No amount of wheedling persuades the fly to enter the spider's parlor, so the spider plans active pursuit. Speed is important. But what route is shortest? The spider's vantage point is one foot below the ceiling in the middle of one of the short walls. The fly is one foot above the floor at the center of the opposite wall.

No hints this time, but we'll tell you 42 feet is *not* the shortest straight path there. Nor did the spider spin his way over! (Answer next month.)

Answer to last month's P-O-T-M: Two knights traveled 4 m.p.h. on level ground, 3 m.p.h. uphill, 6 m.p.h. down. Gone 6 hours, how far did they go?

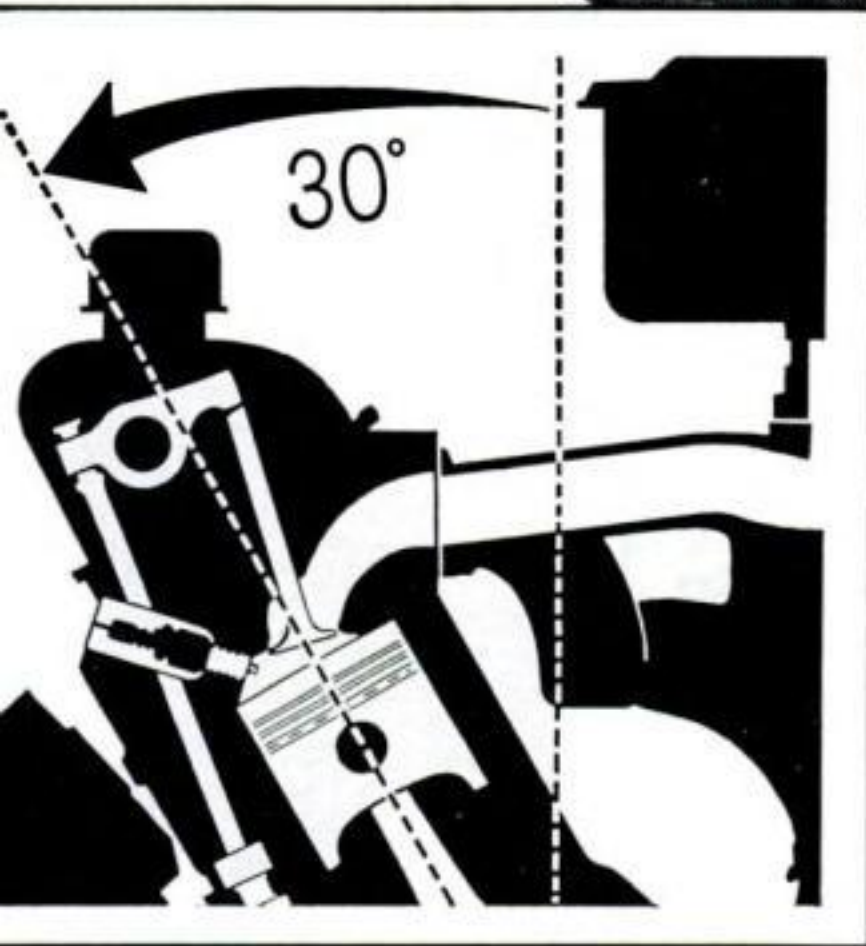
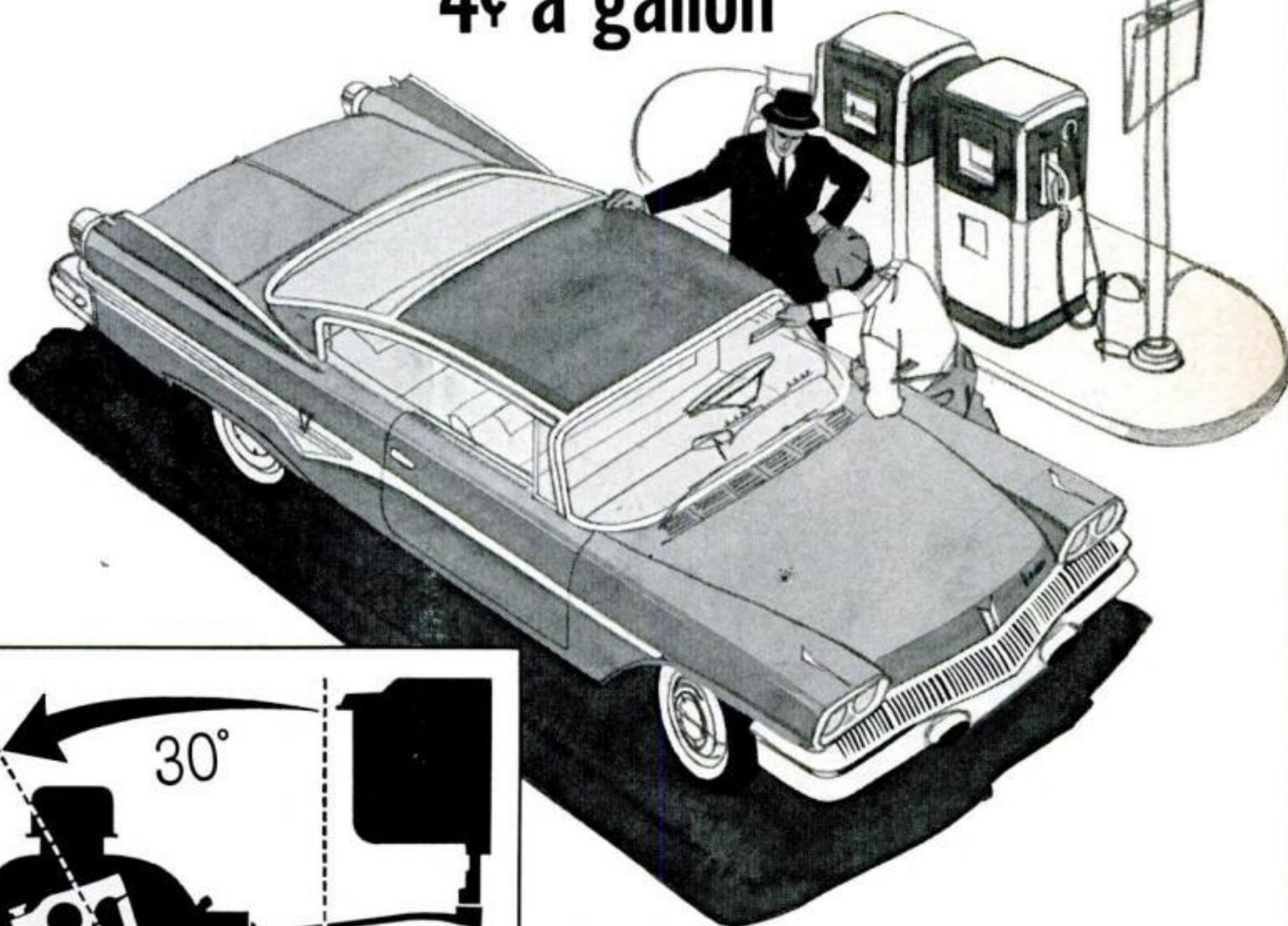
It takes the same time— $\frac{1}{2}$  hour—for them to go and return along one level mile ( $\frac{1}{4}$  hour +  $\frac{1}{4}$  hour), as it does along one hill mile ( $\frac{1}{3}$  hour up +  $\frac{1}{6}$  hour down). So whether on hill or level, their round-trip average was always the same: 2 miles in  $\frac{1}{2}$  hour, 4 miles per hour. Thus,

in 6 hours, the two knights went 24 miles.

If the 12 miles out had been nearly all along level ground, the time they reached the peak would be a little more than 3 hours after they started—a bit past 6:00. If the route had been nearly all hilly, they would have taken almost 4 hours to reach the peak—the time would be a bit before 7:00. So when the young knight was asked the time within  $\frac{1}{2}$  hour when they reached the peak, he should have said 6:30.



# You'll think they've cut the price of gas 4¢ a gallon

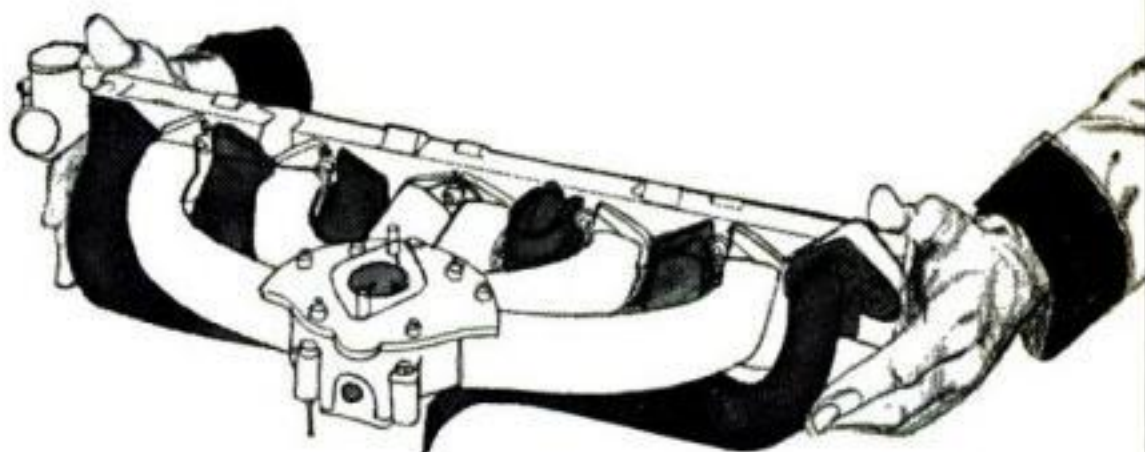


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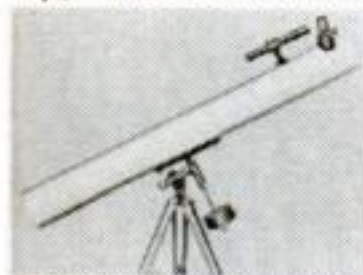
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# The month in science

**Machine-written magazine.** American chemists are now picking out of their mailboxes the first magazine to be prepared cover-to-cover by an electronic computer. The machine-made editorial matter is not exactly lurid. The magazine is called *Chemical Titles*, and that's precisely what it contains: 104 pages of titles of articles on chemistry selected from 550 journals (including 100 Russian) and arranged alphabetically by key words.

NETWORK IN CONTEXT INDEX

IC ACIDS OF THE LEAVES, ROOTS AND NODOSITIES OF THE HORSE BE	COICY -60-COA
CELL-GROWTH OF PLANT ROOTS, INORGANIC SALTS AND NATIVE SE	ROENN-60-CPR
OR THE DETERMINATION OF CASIN ACIDS IN TAL OIL.	SHEEH-60-RMI
ES. CALCULATION OF THE ROTARY DISPERSION OF THE ALPHA HELIX	TINOCI-60-ORO
ON OF CHROMIC ACID ON A ROTATING DISC ELECTRODE.	BUDEVE-60-KER
OLECULES WITH SYMMETRIC ROTATIONAL BARRIERS.	THOMHB-60-EMM
ELECTRIC MOMENTS AND ROTATIONAL CONFORMATIONS OF THE PENT	THOMHB-60-EMR
TO RESTRICTED ROTATION.	HALLDM-60-RR
RESTRICTED INTERNAL ROTATION IN PROTONATED AMIDES.	SPINNE-60-RIR
SYSTEM OF THE MAGNETIC ROTATION OF BOND.* SIGMA BONDS IN TH	GALLAF-60-ESM
OF BICYCLIC QUATERNARY SALTS. SYNTHESIS AND BASE DEGRADAT	MEINWJ-60-ERR
DIARYL IODONIUM SALTS. SALTS IN WHICH THE CATIONS B	BERIFM-60-DIS
ROSO PYRAZOLONE TO FORM SALTS. SILVER SALT. (GER.)	HOVORV-60-AIP
Y OF LIQUID METALS WITH SALTS. SODIUM-SODIUM HALIDE SYSTEMS	BREDMA-60-MLM
TIC SYSTEM. TROPILUM SALTS AND BENZENE.	VOLPME-60-NMC
PLANT ROOTS, INORGANIC SALTS AND NATIVE SERUM PROTEINS.	ROENN-60-CPR
MERCAPTOALKYLAMMONIUM SALTS AND THEIR DISULFIDES.	BOHMEH-60-WMS
F QUININE AND QUINIDINE SALTS AND THEIR HYDRATES.	KIRIDM-60-PEB
N OF OXIDES IN FLUORIDE SALTS BY HIGH-TEMPERATURE FLUORINATI	GOLDBG-60-DOF
UCTANCES OF MULTIVALENT SALTS IN AQUEOUS SOLUTION.* ZINC SUL	DYEJ -60-TNC
DIARYL IODONIUM SALTS. SALTS IN WHICH THE CATIONS BEAR CARB	BERIFM-60-DIS

Center column of machine-edited magazine for chemists lists articles alphabetically by key word. Left column provides additional words from title to clarify meaning; right

column is code guiding reader to article's complete title and source, which are printed in bibliography. Excerpts above point out two of several listings for one article.

The idea is to tip off a chemist quickly to research discoveries in areas he's interested in. Speed is what is important. No chemist can read all (or even very many) of the journals; digests of the journals (such as *Chemical Abstracts*) are slow getting out; indexes to the digests are slower yet.

Only an automatic computer could prepare the new *Chemical Titles* fast enough to make it worth publishing. The IBM 704 takes a little less than 12 minutes to edit an entire issue. Printing takes another 18 to 20 hours. The magazine gets to a reader no later than three weeks after the journals it indexes would have arrived (assuming any reader would subscribe to all those 550 journals).

With a computer to do the brainwork, the job is easy. As the articles are selected, girls at the American Chemical Society office record the titles and authors on punch cards. Then machinery takes over. Tape reels spin, indicator lights blink, and the electric typewriter prints out the index. This lists the titles in alphabetical order for every important word in each title. The computer ignores unimportant words (it has memorized 960 of these) that wouldn't help chemists. If the title contains a dozen important words, it will appear in the index a dozen



## The month in science continued

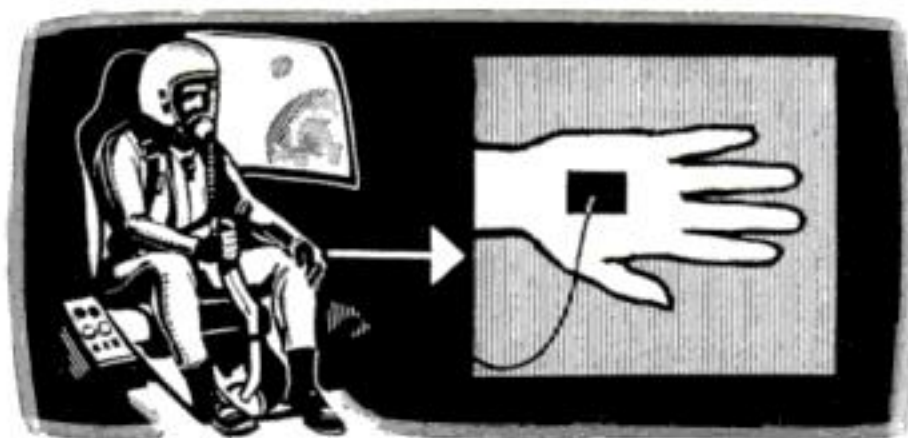
times. The typewritten sheets are made directly into printing plates by a photographic process—no typesetting is necessary.

All a chemist gets from the machine-made index is a reference. That's enough. If the title seems interesting, the index tells him where to find the original article.

**"I feel you loud and clear."** Air Force technicians are now working the bugs out of a mechanism to send messages to pilots through their skin. With electronic navigation and communication devices multiplying in the cockpit, eyes and ears are overloaded. So the Air Force decided to check out the sense of touch as another channel for transmitting information to the human brain. Presumably intelligence experts are also eagerly awaiting its perfection for application in espionage.

The feelie communication system is based on the method that deaf people use to distinguish sounds by touch. It is considerably more complicated, however, for touch is not nearly so acute as hearing. Human speech varies from about 50 to 1,000 cycles per second, and small differences are important.

To overcome this obstacle, Air Force scientists first tape-recorded 39 basic speech sounds, called phoniums, such as "th" and "in." Each of the 39 produces a different pattern on the tape. Practically any word in English can be duplicated by combining the appropriate phoniums. Next these phonium recordings were slowed down (to  $\frac{1}{8}$  the original speed) so that the human skin could discern the frequency differences among the phoniums when they were played back.



Volunteers then learned the individual phoniums, as transmitted to the skin by the vibrations of a small plate. Once these were learned, the phoniums were combined into words. Finally, complete messages were transmitted. The plate can be placed anywhere on the body.

Feelie communication could be more practical than conventional methods when pilots are flung out into space. Although space travel might affect an astronaut's sight and hearing, the sense of touch should not change.

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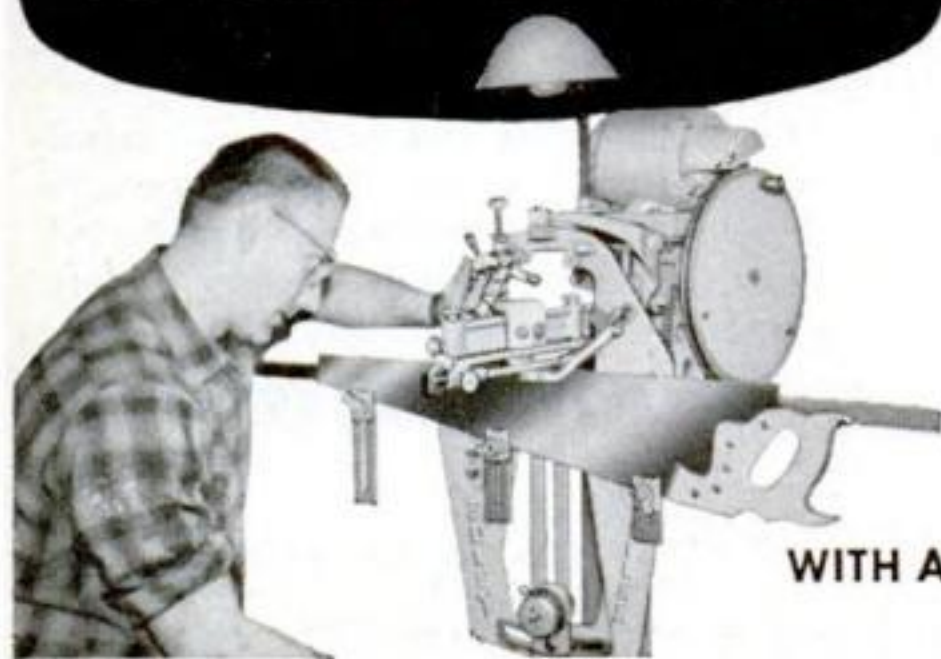
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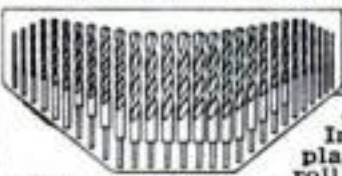


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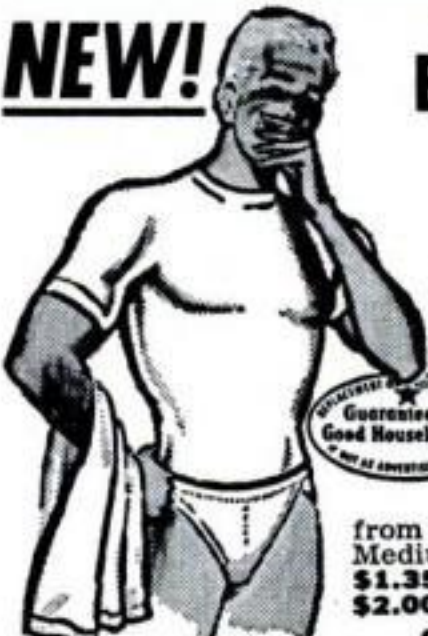
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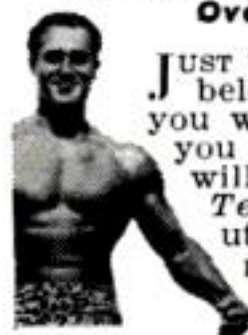
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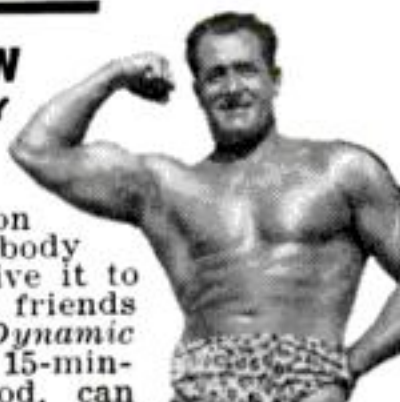
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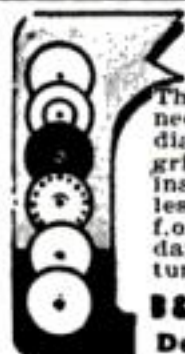
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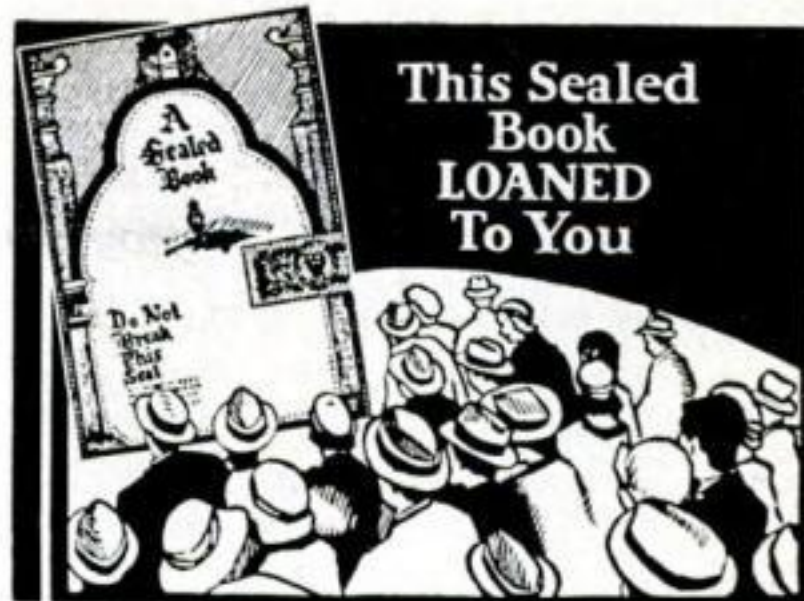


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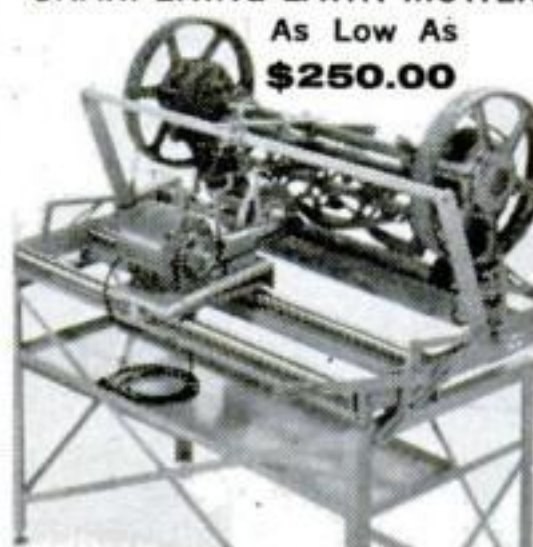
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## Reducing Diet for Engine Blocks

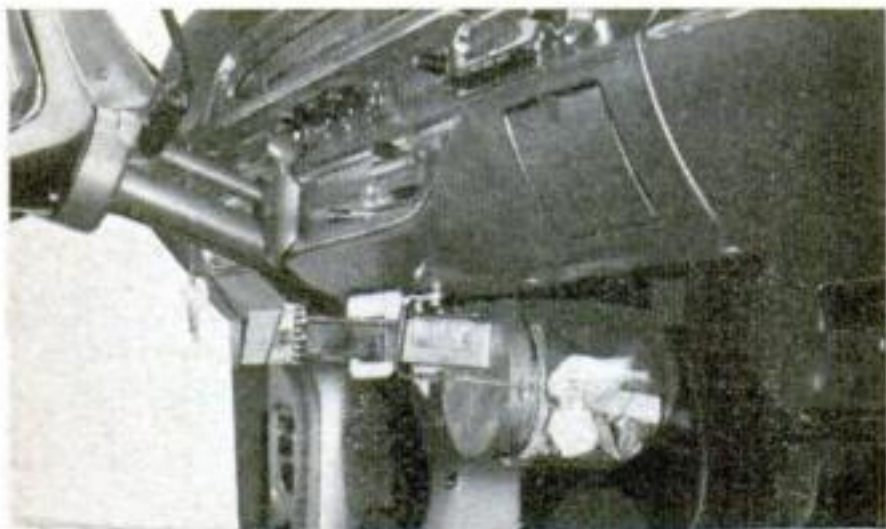


**Magnesium to lighten cars.** Auto engineers, getting more weight-conscious all the time, are planning instrument panels, interior trim pieces, fuel pumps, transmission parts and housings, and horn castings of magnesium. The metal weighs only two-thirds as much as aluminum, and less than one-fourth as much as cast iron.

Some magnesium parts will show up in 1961 models (see p. 59), more in 1962 cars. Farther off, but already in the

experimental stage, are magnesium engine blocks. GM has several under test at its Tech Center.

Current interest in the very light metal is heightened by a recent price cut in the alloys used for permanent-mold and die castings. Dow Chemical, the magnesium refiner, also gives a special 2½-cent-per-pound "development allowance"—off the new low price—to customers buying the metal for experimental automotive use.



**Power-operated ash tray.** No gag. It's here at last. For \$13.25 Ford dealers will sell you a vacuum-operated trash jug that automatically swallows up butts (hot or cold), crumpled parking-lot checks, apple cores, and candy wrappers.

All you see of this amazing invention is an under-dash ash tray, but behind it is a half-gallon fireproof glass container that is hooked up to manifold vacuum. Pulling out the ash-tray drawer unleashes suction which gulps trash from the drawer and into the jug. Lighted butts smother inside the jug when the vacuum valve closes.

Chevy is offering a similar accessory at about the same cost.

**Knee action** to open your trunk? This no-hands lid-lifter is one convenience that could come with a centralized hydraulic system. Electric Autolite is using the showy gadget to push its idea for one engine-driven pump to operate accessories that now are powered individually. It could work power brakes, steering, window lifts, seat shifters, and transmission control.



**Turn signals to turn amber?** Tests by the Automobile Manufacturers Association reveal that amber turn signals are easier to see than white ones, both day and night. The white lamps, now standard for front signals, can be hidden by sun reflection in daytime. At night, they fail to contrast with headlamps. State laws regulate the colors of auto lamps, so AMA is urging motor-vehicle administrators to legalize amber.



# AUTOLITE SPARK PLUGS SPARKED MORE THAN TWICE AS MANY MOBILGAS ECONOMY RUN WINNERS AS ALL OTHER SPARK PLUGS COMBINED



*Another Autolite-equipped winner crosses finish line.*

A near clean sweep for Autolite Spark Plug equipped cars was registered in the 2,061-mile Mobilgas Economy Run between Los Angeles and Minneapolis.

Here's proof *positive*: Under *all* driving conditions—city or country, fast or slow speeds—*one* spark plug stands out over all others—AUTOLITE.

Regardless of the make of car you drive . . . there's an Autolite Spark Plug ignition-engineered to give you top performance and economy. See your nearby serviceman and insist on ignition-engineered Autolite Spark Plugs.



The Mobilgas Economy Run is rigidly supervised by observers provided by the United States Auto Club.

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4 OF 6 FIRST PLACE WINNERS

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5 OF 6 SECOND PLACE WINNERS

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2 OF 5 THIRD PLACE WINNERS

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11 OF 17 TOP POSITIONS

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## AUTOLITE SPARK PLUGS



IGNITION-ENGINEERED FOR ALL CARS

Now! Autolite sponsors the election news with Dave Garroway on NBC-TV TODAY Show—and "News on the Hour," NBC Radio.



## PS Readers Talk Back

[Continued from page 16]

action Motors Division, it will generate up to 150,000 hp., enough energy to launch a 100,000-lb aircraft at a speed of 125 knots.

In essence, the power plant is a combustion system using, as propellants, compressed air, jet fuel, and water, which through a system of servo controls and pumps creates and maintains a desired cylinder pressure. The ICCP is in effect a flash boiler which creates high-temperature steam by burning propellants in the presence of water. The hot combustion gases and steam are fed from the combustor assembly into the catapult tubes where they propel the pistons that pull the aircraft up to launching speed—in two seconds.

TOM JOHNSTON

Brown & Butcher, Inc., NYC.

### The Stretching Inches



JUST noticed in the April issue that a Mr. Pelsang ["I'd Like to See Them Make"] wants a "tape-measure" belt.

My family has been manufacturing belts for over 60 years. A combination

belt and tape measure would be impossible to manufacture. A leather (or cloth) belt stretches from the constant tension under which it is placed, and this would throw the tape measurement off.

This stretching also accounts for the "loss of weight" so many people have when their belts become too large.

PETER HOROWITZ, Yonkers, N.Y.

### Truck Hater Lets Off Steam

YOU really fell down in my opinion with that April cover and lead story on turnpike trains. With all the high-powered things to expound on, you put a stinking diesel truck—and a supermonster at that—on the cover! This development means just so many more road hogs on the highway and more blinking of lights in passing at night. And just consider trying to pass one of those things!

Here the railroads are struggling to

make a comeback with piggy-back freight and now these things come along. Please, no more glorifying of trucks. Let's have some articles on how to get them off the road.

B. P. WOODWARD, Studio City, Calif.

### Any Ideas on Old Socks?

MAYBE some of your readers could help me. I'd like to find some good use



for discarded socks. Many of us men wear out the heel or part of the foot section while the top of the sock is still as good as new.

Anybody got any ideas?

EDWARD SANDER SR., St. Louis.

### Better Braking

A LOT of motorists are going to have brake failure in 1960. One answer to that would be combination brakes. When the brake pedal goes to the floor, it would engage four-wheel mechanical brakes. It would work even if one wheel assembly was knocked off.

This mechanical emergency-brake system would be similar to the four-wheel brakes that were used on Ford cars in the Forties.

The same brake pedal should be used because it takes too long for a driver to shift his foot to another pedal.

WILLIAM GRUMM, Lancaster, Ohio.

### Tip for Car-Radio Owners

THE way they make automobile-radio vibrators, you can't get at the contacts when they short out. But I have used a hacksaw to remove the top, so I could reach the contacts to file and reset them properly.

It works fine, giving extra years of service to an item that costs several dollars to replace. Some of your readers might like to try this.

P. D. BABA, Elizabeth, N.J.





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*\*In 1959, there were 126 motor models on the market—ranging in size from 1½ hp to 70 hp. Of these, 1 in every 11½ motors bought was an Evinrude Lark.*

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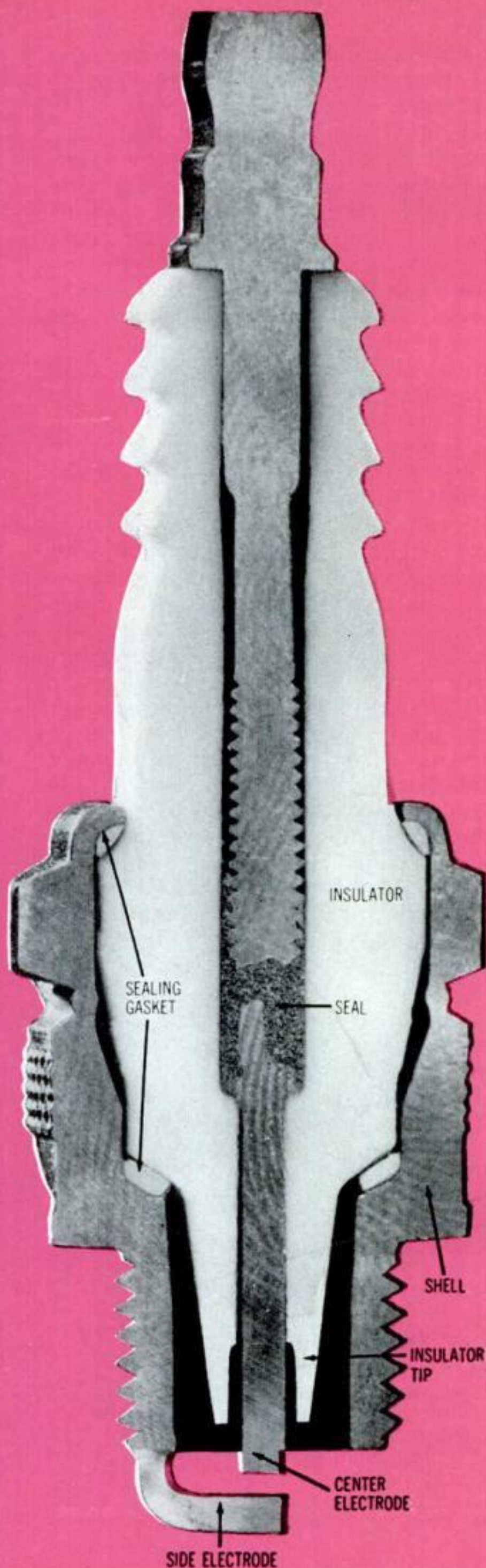
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*You'll get more out of your car if you know—*

# The Truth About Spark Plugs

*By Hubert Lockett*



**S**PARK plugs have been the subject of more pseudo-scientific baffle-gabble, misrepresentation, and folklore than any other part of an automobile. Although spark plugs are basically simple devices, few mechanics—and even fewer car owners—have really understood the factors affecting their performance. They weren't alone: Even auto engineers have been mystified by certain quirks of spark-plug behavior. Recently devised instrumentation,

CONTINUED





**NORMAL**



**LEAD-FOULED**

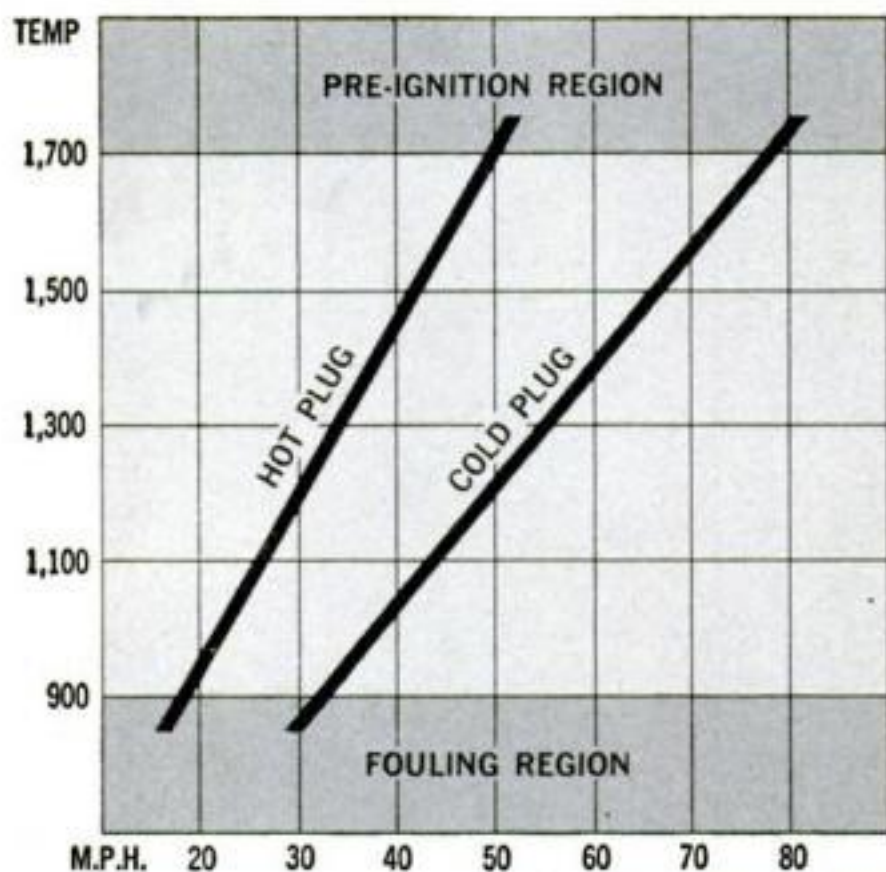


**OIL-FOULED**



**WORN ELECTRODES**

**COMMON PLUG TROUBLES:** Oil fouling indicates engine is pumping oil; excessive electrode wear is caused by a lean fuel mixture, a plug that's too hot, or a poorly seated plug gasket.



**OPERATION OF HOT AND COLD PLUG** with load variation: Hot plug heats more rapidly but runs into the pre-ignition zone at lower speeds.

however, has explored what actually takes place inside a working engine, and now the mysteries are fast dwindling.

A *spark plug's job* is to start a fire inside a cylinder at the right time. Once it starts the fuel-air mixture burning, its job is finished. A plug has no effect on how much power the burning fuel delivers. A fatter, longer, or hotter spark can't make the fuel charge burn with any more energy. By analogy, the flame in your cigarette lighter doesn't burn any hotter when you have a fresh flint in it.

But just as a lighter may fail to light at the first flick, the fuel charge in an auto's cylinder may fail to ignite. When this happens you get *no* power from the cylinder, and the fuel in that particular charge is wasted.

Parenthetically, a spark plug has little or no effect on the grade of gasoline your engine requires. Higher-octane gas is needed in some engines because of basic design characteristics—not because premium gas makes up for spark-plug deficiencies. The latest in mail-order magic can't change this. And calling a spark plug by a fancy name doesn't change its function. It still works by introducing an electric spark into the cylinder.

Here are some basic points on misfiring—the equivalent of the unsuccessful lighter flick:

- Misfiring will occur if a plug requires more voltage than the ignition system delivers.
- Misfiring will occur if the high voltage gets sidetracked before it can fire the plug.
- The more heat energy a spark can bring to the fuel mixture, and the more fuel molecules reached by this heat, the less chance there is of misfiring.

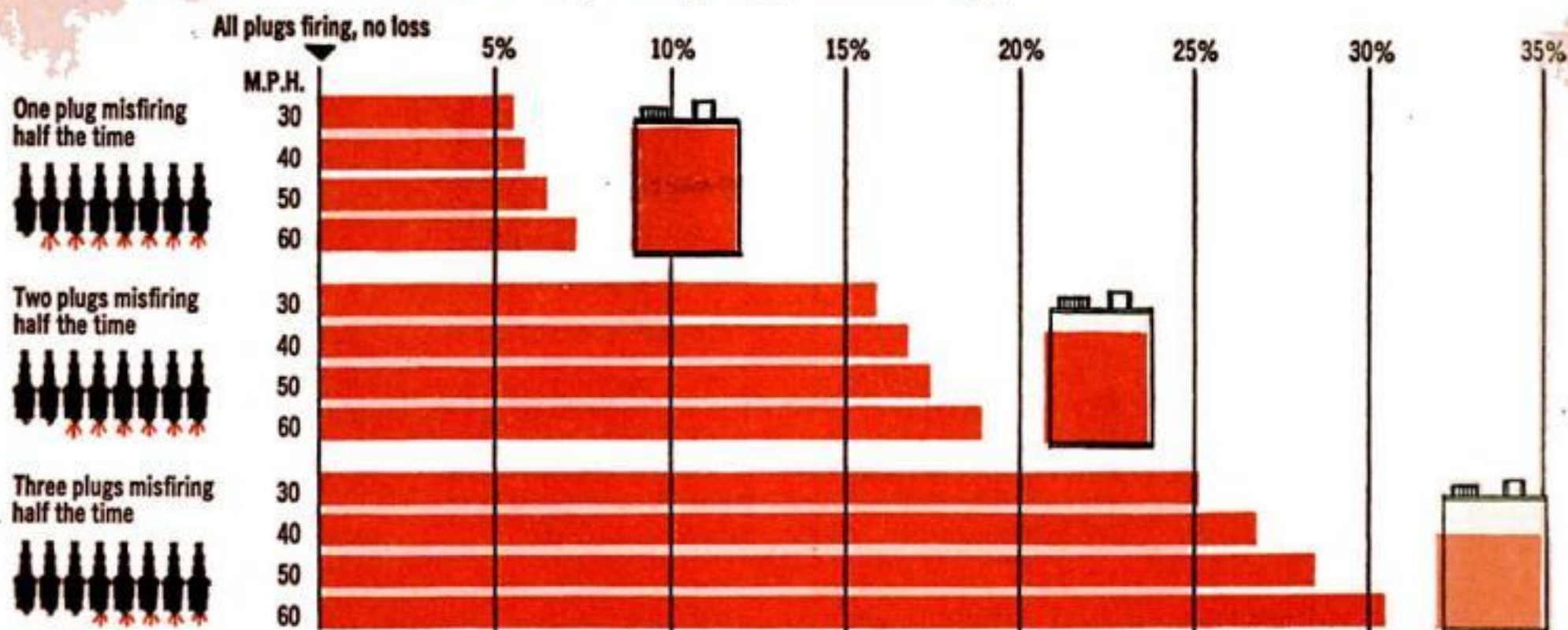


In gathering material for this article Technical Editor Hubert Luckett talked to engineers at major auto, spark-plug, and oil companies; observed laboratory tests; studied dozens of technical papers from industry and government; analyzed reports from independent testing organizations; and managed to get access to some confidential reports at two major automotive companies.

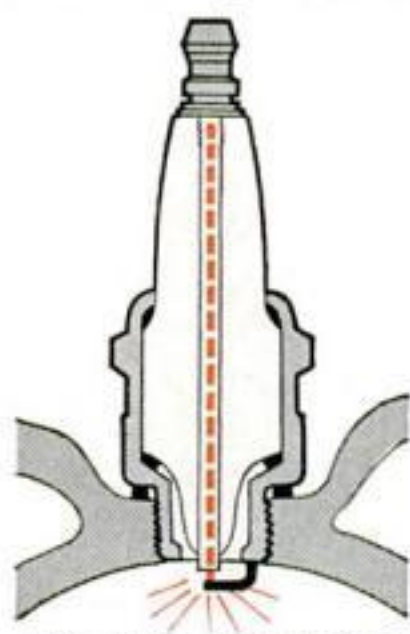
To supplement this with firsthand experience, he ran a little test program of his own. For a year he used a variety of plugs in his own car, keeping careful records. Performance was monitored periodically with an oscilloscope ignition analyzer rigged to operate while the car was on the road.



## Gasoline wasted due to spark-plug misfiring

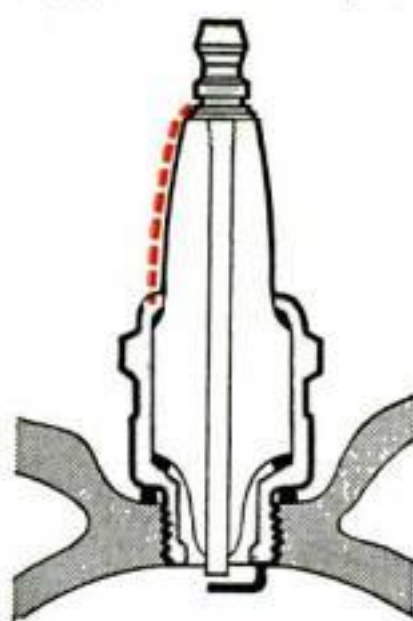


## How high voltage goes astray and causes misfiring



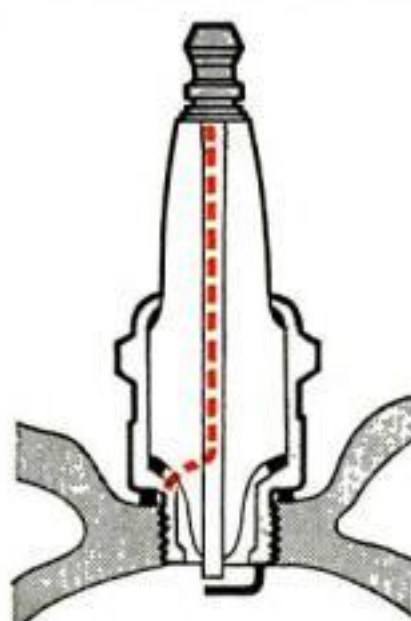
**NORMAL SPARKING**

Normal sparking occurs when ignition voltage builds up to a high enough value to jump the gap between plug electrodes.



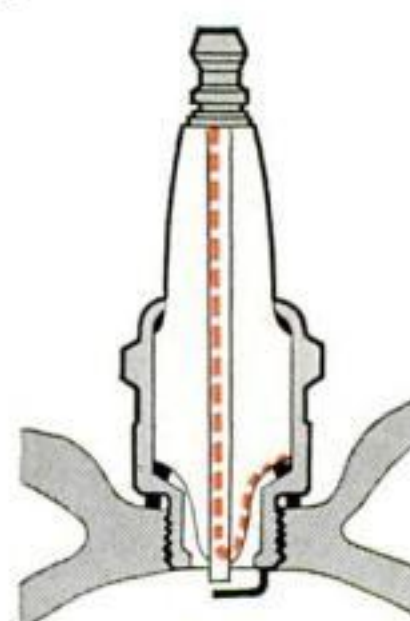
**FLASHOVER**

Low-resistance path along the outside of the insulator lets high voltage flash over to ground instead of sparking at gap.



**CRACKED INSULATOR**

Crack in insulator allows high voltage to discharge to the spark-plug shell before there's enough voltage to jump the gap.



**FOULED PLUG**

Partially conductive deposits on insulator nose leak current to ground, thus lowering voltage available to fire the gap.

### *Voltage available vs. voltage required.*

A typical ignition system in good condition delivers more than 20,000 volts at 25 m.p.h. But the same system may deliver less than 15,000 volts at 75 m.p.h., because of the reduced time available for field build-up in the coil. With only casual maintenance—the kind most cars get—maximum voltage can easily drop below 10,000 volts at high speeds.

The first requirement that must be met by a spark plug, then, is that it be able to fire (preferably with a generous margin of reserve) at these reduced voltages.

As far as a plug is concerned, voltage required varies with (1) the length of the gap, (2) the shape of the electrodes, (3)

electron emission from the electrode, and (4) the immediate environment of the gap. A narrow gap requires less voltage. Pointy or sharp-edged electrodes fire at lower voltage than smooth, rounded ones. A hot center electrode emits more electrons, lowering the voltage needed for a spark. Finally, an insulator spanning the gap increases the gap length that can be fired with a given voltage.

The pressure inside a cylinder also affects voltage required. The higher the pressure, the higher the voltage needed to jump the gap. This is why missing usually shows up first during acceleration. When you step on the gas, pressure inside the cylinders rises sharply.





#### STANDARD

Center electrode tip is even with bottom of shell. Side electrode extends over it. Spark is exposed to fuel mixture on all sides.

#### EXTENDED-NOSE

Tip extends farther into combustion chamber. One make also extends shell to shorten side electrode. Useful heat range is wider.

#### MULTIPLE-ELECTRODE

Spark occurs at one point, moves as electrodes wear, seeking path of least resistance. Longer electrode life is claimed.

#### SURFACE-DISCHARGE

Spark occurs along insulator surface, across air gap to shell. It is longer but only one side is exposed over most of length.

Worn plugs generally misfire because they need higher voltages than they get—electrodes become rounded and the gap grows wide due to erosion.

Filing the electrodes and adjusting the gap of used standard plugs will reduce the voltage they require. Incidentally, despite claims to the contrary, *all* types of spark plugs do have electrodes.

The practical significance of electron emission can be shown neatly but painfully. At typical operating temperatures, voltage requirement increases about 40 percent if your ignition coil is accidentally connected with the wrong polarity. The center electrode, as the hotter electron-emitting surface, should be negative.

If you place an insulator between two electrodes, the voltage required will be less for a given electrode separation. The presence of the insulator concentrates the

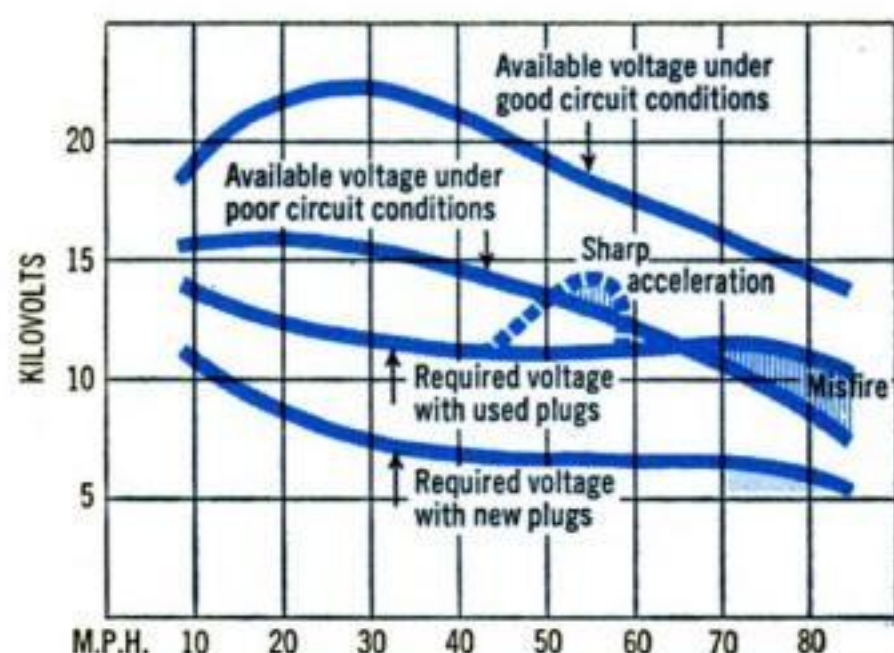
electric field, causing the gap to break down at a lower voltage. This is the theory behind the widely advertised surface-discharge plugs.

To work with a standard ignition system, these plugs must also have an air gap. Although the ads often claim they have none, the total air gap in the plugs I measured was .023 inches—not so much less than the standard gap for many engines.

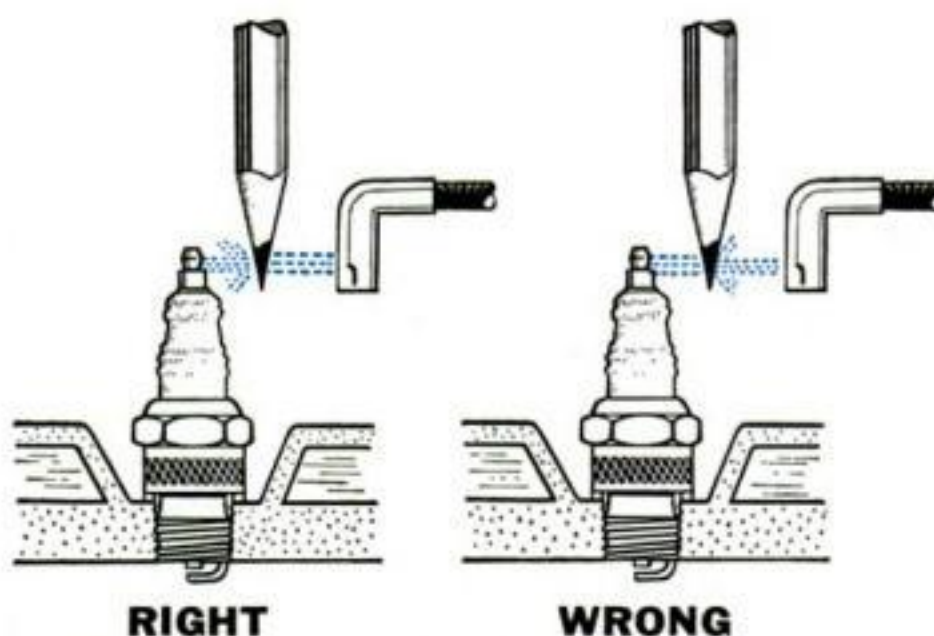
**Sidetracked high voltage.** Dirty plugs are bad actors. Outside, moisture and dirt on the insulator may cause flashover to ground. Inside, carbon deposits or oil may actually bridge the gap or collect on the insulator nose, shorting the plug.

Lead fouling, however, is by far the most common and troublesome type of spark-plug sickness in modern cars. It

[\[Continued on page 200\]](#)



**CURVES SHOW VOLTAGE** available vs. voltage required for different operating conditions. Available voltage drops as engine speed rises because breaker points must operate faster, interrupting the primary current before it reaches maximum. Plugs fire at lower voltage as they get hotter. This is offset at higher loads by an increase in the cylinder pressure.



**REVERSED COIL POLARITY** can increase voltage required as much as 40 percent. This can cause hard starting, rough idle, and misfiring during acceleration and at high speed. Insert a wooden pencil between wire and plug terminal with engine running. If spark feathers and flares on the side toward the wire, the connections should be reversed; if on the plug side, they're okay.





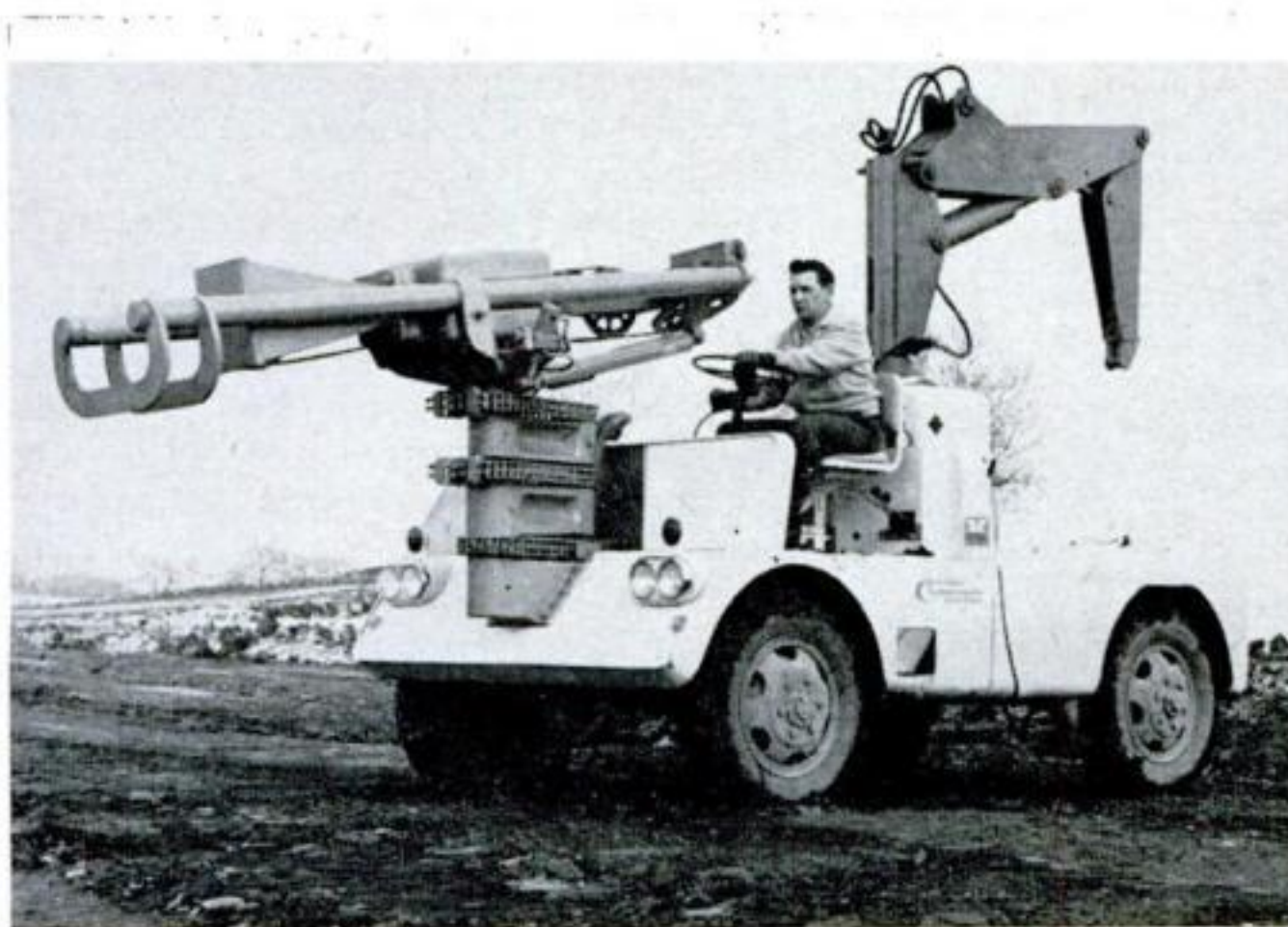
Water skier can control boat maneuvers . . .

## Intercom on the waves

A combination mike and speaker on the tow bar and another in the boat put skier and skipper in two-way communication while skimming the water. Connecting wires are woven into the towline. Ski-Talkie can be powered either by dry batteries or the boat's starting battery. Air-guide Instrument, Chicago, makes it.



. . . or get instructions from the skipper.



## Rolling tool holder

This combination truck tractor and power unit has mounts front and rear for 10 attachments. Tools include the road tamper shown, a back hoe, crane, high-lift platform, bulldozer, broom, and fork lift.

The rig can travel from a near-zero crawl to 35 m.p.h. and turn in a 24-foot circle. Called a Commando, it's made by Ottawa Steel, Ottawa, Kan.





# Who Says

***Hop on a bike and enjoy life, says the author. It's fun, and it's even good for you***

**By Evan Wylie**

"**W**HAT are you doing on that bike?" my wife asked me in astonishment one afternoon last spring. It seemed a fair question. We had driven downtown to buy a tricycle for our three-year-old son. Purchase completed, I paused beside a blue-and-white bicycle standing in a rack outside the shop. Its paint was chipped, but the frame looked sturdy. There was a tag on it: "For Sale —\$22." I found myself mounting it. Gripping the handlebars, testing my toes on the stubby pedals, I shoved off and dizzily circled the parking lot, surprised that I didn't fall off.

"I'm buying it," I said suddenly.

"You can't be serious!" my wife exclaimed.

By way of reply I handed the shopkeeper his price and wobbled off down the street, self-propelled for the first time in several decades.

Just outside of town was a house bearing a historical marker. For years I had intended to stop long enough to read it, but in a car there was never time. Now there *was* time. I braked and read the sign's description of an Indian trading post that had flourished on the spot 250 years before.

The sun was warm on my cheek as I peddled along. Upon the breeze that whispered softly—then quickened as I coasted down a little hill—were blended the scents of spring blossoms, the warm tar of the road beneath my wheels. Near-forgotten sounds and sensations nudged my memory: the measured *rat . . . tat . . . tat* of a carpenter's hammer, the squeak of a clothesline pulley, the whir of a child's roller skates.

I gazed leisurely around, gawked at a bulldozer, spied a hawk wheeling high in the sky, and swiveled around to watch a man calking a boat in his back yard. By the time I swung into my driveway, I re-



# Bikes Are for Kids?

alized I had broken through an invisible seal that had long separated me from the human side of the village in which I lived.

For years I had been dwelling in communities with tree-shaded streets, pleasant patches of woods, and vistas of green fields. Yet to fetch anything from a thumbtack to a Sunday newspaper I had automatically stepped into my car, pressed buttons and levers, and sat passively while the machine propelled me past a blurred landscape to the shopping center.

Now all this has been changed. To get newspaper or haircut or dog license, to take shoes to the shoe-maker or book to the library, I go by bike, which I am convinced is one of the most beguiling contraptions ever devised for the benefit of man. I have reached this conclusion although my bike has taken me no farther afield than back and forth to the village and down a few winding country lanes. I have joined no cycling clubs nor engaged in any organized contests of stern-up, head-down speed, daredevil skill, or stamina. My interest in biking remains limited to the private fun in keeping track of the way the world is spinning in my neighborhood.

The bike, pumped in leisurely fashion, provides just the right speed for glancing inquisitively into back yards, admiring your neighbor's flower beds and following his progress with the new screened porch. Bowling along, I can gauge how effectively the battle against crabgrass is being waged on a dozen other lawns. The pungent aroma of cow barn, honeysuckle, hayfield, and ripening wild grape reaches you intact rather than whipped in one car window and snatched out the other by a 40-mile-an-hour slipstream.

I know now that the stream on my

route to town gurgles ebulliently in the spring, because I have paused and listened. I am aware that few sounds are more nostalgically allusive than the low, self-satisfied whistle of a small boy heading home through the twilight with a football helmet dangling from his handlebars. The merchants and other townsfolk seem closer to me because I have stopped and read the names of their sons and brothers who did not return from the war.

The pace of a bike is one of its most ingratiating features. You can set your speed to fit your mood.

When the crisp morning air puts me in an effervescent mood, I hit a merry clip that sets the wind whistling past my ears. Yet if I wish to dally aimlessly, gazing at the cows in a pasture or ducks in the pond, I can do so without stirring up a chorus of reproachful honks from behind.

The first few times I rode my bike into town the indulgent smiles and stares I

stirred up among pedestrians and motorists reminded me that in this country today an adult on a bicycle is likely to be taken for a quaint character. But very quickly I was pleased to find that I had a few allies. At a sand-lot baseball game I chatted with three fathers who had cycled across town to watch their sons play ball. Tied down to rigid commuting schedules during the week, all three had bought bicycles for weekend joyriding.

*Vacation fun.* Rolling down a back road shortly after, I encountered a middle-aged couple pedaling along on twin red-and-white two-wheelers whose handlebar baskets held Thermos jugs, sandwiches, and the Sunday paper. During a recent European holiday, they explained, they had been struck by the number of

## *Comment from a noted heart specialist:*

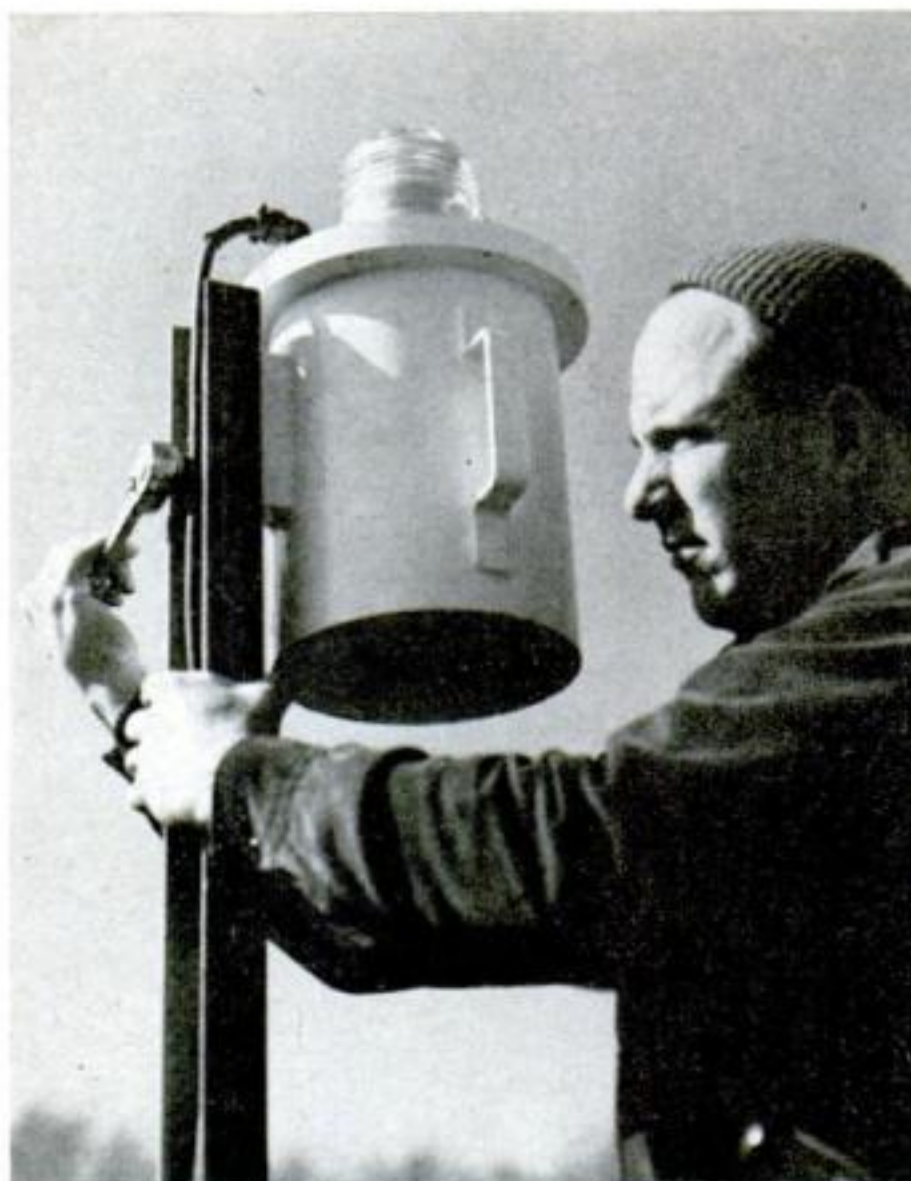
"In this country we have become committed to a pattern of life that is really doing grave damage to our bodies. We no longer get the regular exercise that keeps the muscles, blood vessels, heart, lungs, liver, and intestines in good condition . . .

"I believe the bicycle is the answer for all of us—from age four to age eighty. Pedaling a bicycle exercises virtually every muscle in the body, yet it is not exhausting."

—Dr. Paul Dudley White.

[Continued on page 194]





**LIGHT FROM A NUCLEAR BLAST** would trigger this sensing device and spread the alarm.



**INSTALLED IN TARGET AREAS,** the system would pinpoint the disaster for defense leaders.

## Bomb-alarm system

A nationwide bomb-alarm system is being installed to flash a warning to the rest of the country in case of a nuclear attack. It consists of special sensing devices that react only to the light flash of an atomic bomb—or, in preview tests,

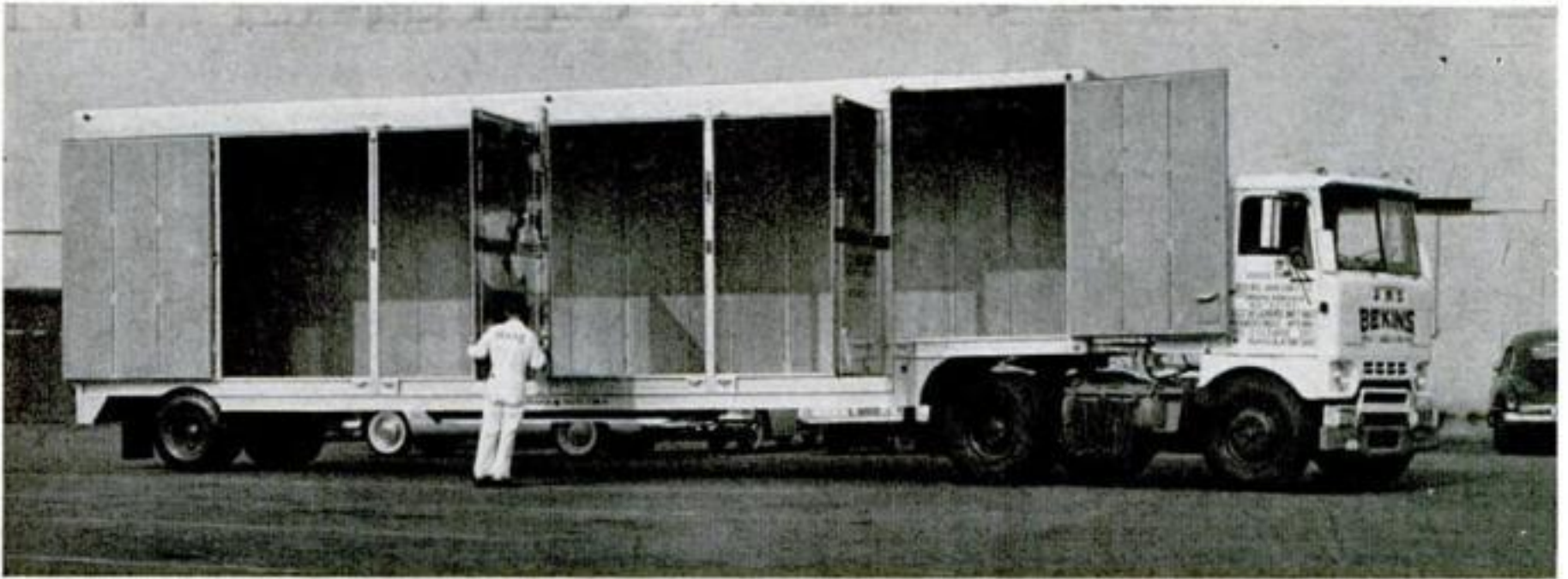
to a simulated nuclear flash in a laboratory. Each is being placed by Western Union, which will maintain the system, on a different circuit leading away from important target areas. If triggered, it will send a warning—both audible and visual—and spot the location of the blast for Air Force command centers.



## Wire news service

A direct cable delivers the newspaper each morning to the bedroom window of Donald R. Larson, who lives in a suburb of Washington, D. C. The cable is a 100-foot wire up which the paper travels on pulleys. A non-ringing alarm clock starts an old kitchen-mixer motor outside the window before he arises. As the motor turns, it winds up a second wire attached to one end of the delivery container.





Doors can be swung open wide, taken out completely, and even have posts between them removed.

### Side-loading van takes on bulky cargo

The whole side of this moving van can be opened for big packing containers. It is made up of doors that can be lifted off hinge pivots, and even the door posts can be removed if necessary.

The floor has two elevations—one over the front wheels—to do away with wheel wells. Eight of the vans have been built by Aluminum Body Corp., Montebello, Calif., for Bekins Lines of Los Angeles.



Big 5-by-7½-by-7½-foot containers are a close fit.



### Wingless plane

Retired from the air, this ski-equipped Navy Douglas Skytrain, shown being pushed onto the Ross Sea Ice Shelf, is

seeing new life in Antarctica. Minus wings, it's now used as a taxicab between the ice landing strip and McMurdo camp. It makes the four-mile trip in 10 minutes, using fuel unfit for flying.



# The Plot to Kidnap Lincoln's Body

By Gardner Soule

**T**HE men sawing at a padlock at right are shown at a desperate moment of one of the weirdest, most ghoulish crimes in history. Their plot:

To steal the body of Abraham Lincoln from the grave at Springfield, Ill., and to demand in return for it—from the U. S. Government—a high ransom. The ransom was to be \$200,000 cash plus the release from prison of a convicted master counterfeiter.

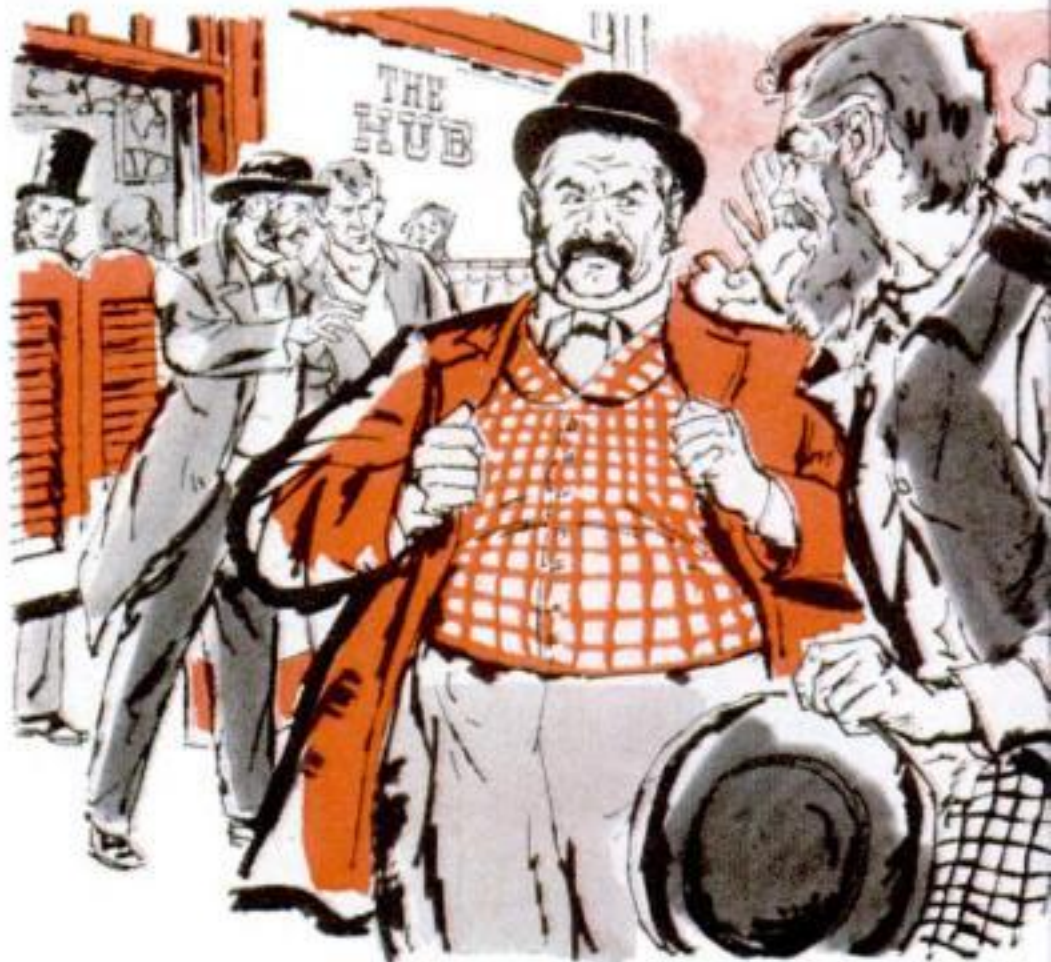
The crime, if it had succeeded, would have become one of the world's most famous. But because it was thwarted by the U. S. Secret Service, it is an almost unknown episode in American history.

The tale of the attempted body-snatching is told in a new book, *The United States Secret Service*, by Walter S. Bowen, who was in the Service for 40 years, and Harry Edward Neal (Chilton Company, Philadelphia, \$4.95).



**WASHINGTON  
1865**

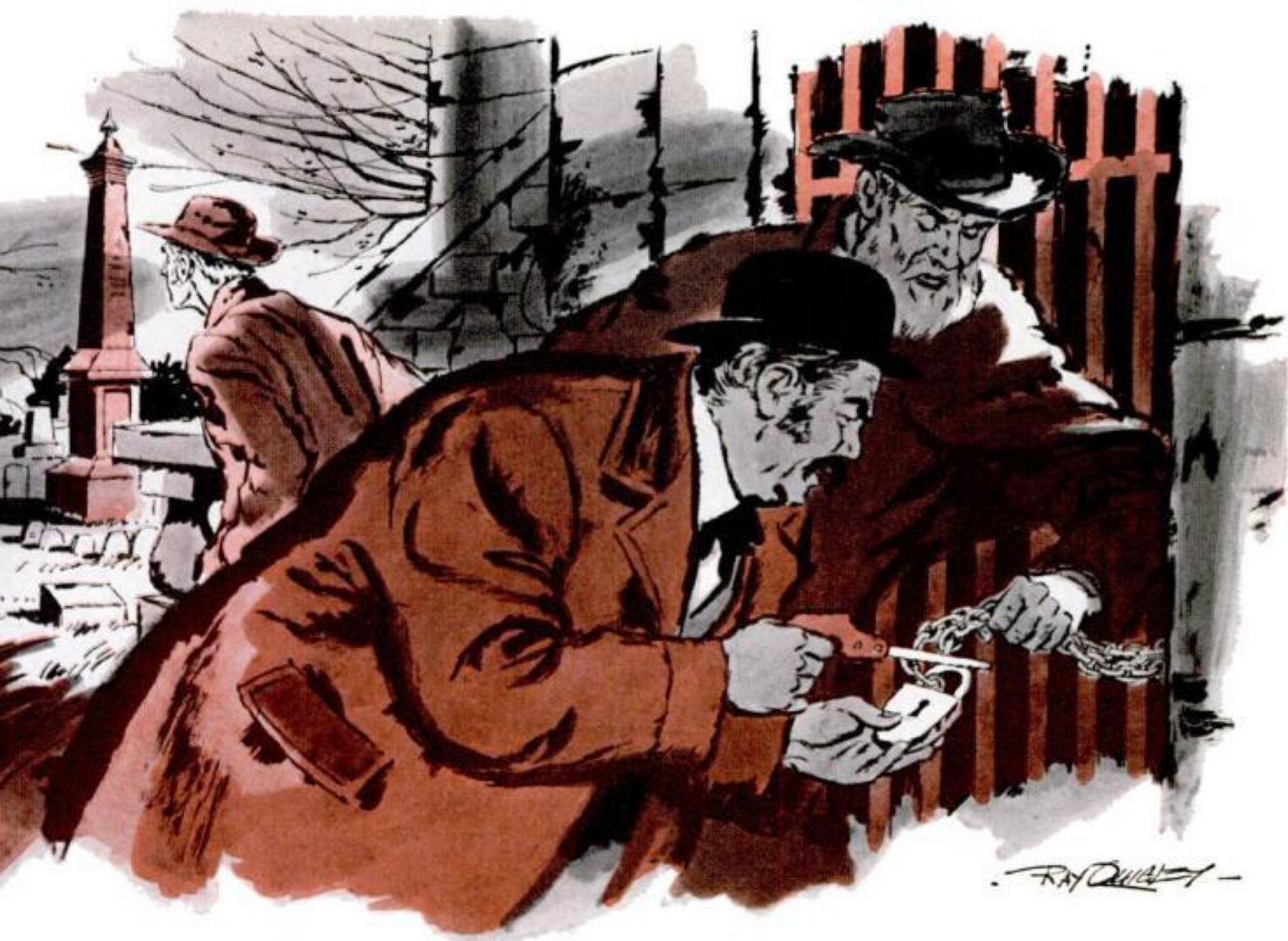
During the Civil War, counterfeiting became so widespread that half the money in the nation was phony. To break up the counterfeiting gangs, President Lincoln authorized Treasury Secretary Hugh McCulloch to establish the Secret Service. This started a war between the Service and counterfeiters that still goes on, and that led to the ravaging of Lincoln's tomb.



**CHICAGO  
1876**

The plot to seize Lincoln's body was hatched, in 1876, by Terence Mullen, owner of The Hub, a small, dirty saloon on Chicago's West Madison Street, a hangout for cutthroats and thieves. From The Hub, Ben Boyd, king of the Midwest counterfeiters, had circulated his bills. The Secret Service arrested Boyd and he went to jail. Mullen schemed to get him out so their profitable racket could continue.





## OCTOBER '76 A 'RECRUIT'

Even with Boyd in prison, Mullen passed what remained of Boyd's false bills. The Secret Service, suspecting their source, assigned undercoverman Louis C. Swigles to frequent The Hub. Swigles played his part well: He actually joined Mullen's gang and won their confidence. He soon had startling news to tell his Government superiors back in the nation's capital.

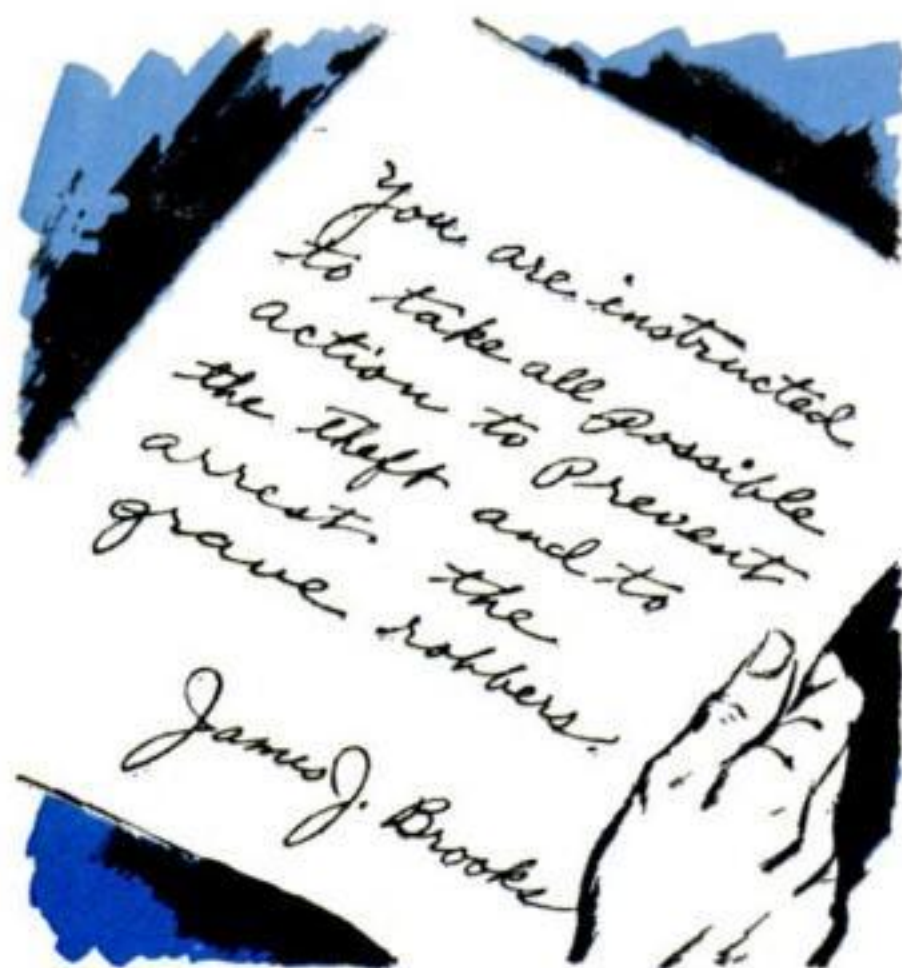


## OCT. 27 THE PLOT

Swigles reported to Secret Service Agent Patrick D. Tyrrell: "Now, Mr. Tyrrell, I know this sounds crazy, but here's what they're going to do. They plan to break into the Lincoln tomb, steal President Lincoln's body, and hide it in the Indiana sand hills." Mullen would return the body after Boyd's release from jail, Swigles explained. No ransom was mentioned at this time.

CONTINUED





## NOV. 1 ORDERS

"They have a jimmy, crowbar, and saw," Swigles reported, "and a team to haul away the coffin." Agent Tyrrell got flat orders from his Chief to prevent the crime and catch the criminals. Swigles found that Mullen would demand \$200,000 besides Boyd's release. The snatch was set for the night of the Hayes-Tilden presidential election (Nov. 7, 1876) to take advantage of congested telegraph circuits.



## NOV. 6 'ALL ABOARD!'

On the night of Nov. 6, Agent Tyrrell and four assistants watched passengers boarding the train from Chicago for Springfield. At the last minute, they saw Mullen, a man named Hughes, and Swigles dash aboard. Tyrrell and his men then clambered onto the last car. Robert Lincoln, the martyred President's son, whom Tyrrell had notified, watched from the platform.



## 6:40 - 8:40 A LONG WAIT

At 6:40 p.m. on the black night of Nov. 7, Agent Tyrrell and his men hid in the cold tomb—near, but not in, the catacomb where Lincoln's body lay. They shivered the hours away: 7:00 . . . 7:30 . . . 8:30. At 8:40 they heard footsteps. Mullen and Hughes were sawing the padlock. Soon they were working the cover off the sarcophagus. Swigles was with them.



## 9:20 P.M. CLOSING IN

Saying he'd check on the team and wagon, Swigles left the two crooks, told Tyrrell how far along they were. Tyrrell and his men approached the catacomb. Unexpectedly, the percussion cap of George Hay's pistol cracked a warning. The detectives ran to the gate. "You in there!" yelled Tyrrell. "Come out! One wrong move and you're dead men!" They waited. There was no answer.





## NOV. 7 TOURISTS

Agent Tyrrell told the custodian at the Lincoln tomb that several men (the graverobbers) might come along and ask questions. He advised the custodian to answer. Jack Hughes, with Swigles, came in the afternoon. He asked about the weight of the sarcophagus and casket, and how they were protected (by a padlock). Mullen rounded up the remaining tools they would need.

## 5 P.M. GUNS READY?

In a hotel room, Tyrrell assembled his agents to go over their plans. "Does everyone have a gun?" he asked. All did. One man, George Hay, displayed an ancient Colt. Commented another: "That's the old percussion-cap model. You can't trust them. Sometimes the cap pops off without firing the cartridge." Laughed Hay: "Don't worry. This old gal hasn't failed me yet."



## 9:25 P.M. THE SHADOW

There was no one inside the tomb. "Search the grounds," Tyrrell commanded. Then he saw a moving shadow behind a column. He and the shadow shot at each other. The shadow called, "Tyrrell, is that you?" No criminal, it was a Pinkerton man from his own party. A search revealed that Mullen and Hughes, alerted by the cap, had got clean away from the cemetery.



## NOV. 17 CONCLUSION

Hughes hid out 10 days. Then he visited his old hangout, The Hub, to see Mullen. Notified by Swigles, Tyrrell and other detectives were there watching through a window. They entered and handcuffed the men together. They were tried, found guilty, sentenced to only one year (for burglary). But the Secret Service that Lincoln founded had kept his mortal remains secure.

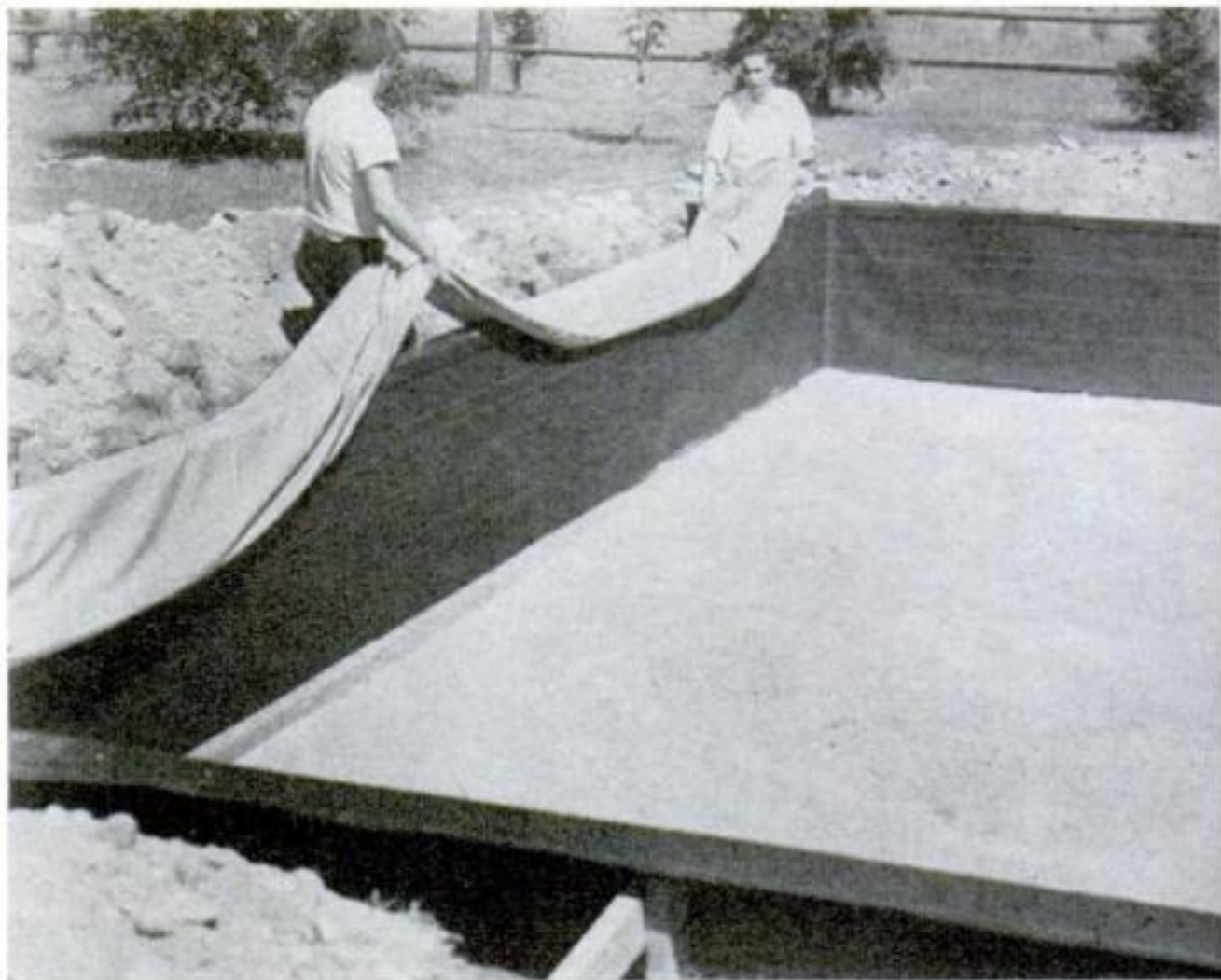


## Do-it-yourself swimming pool

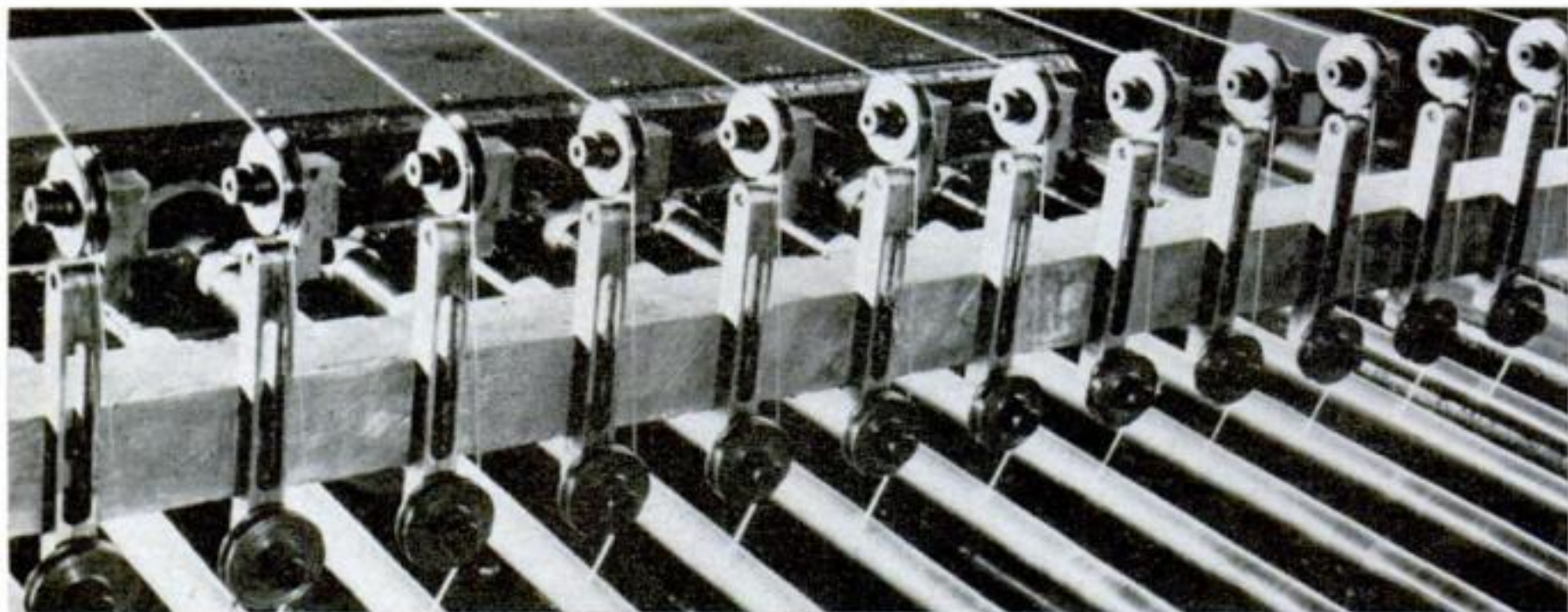
Here's a back-yard swimming pool you can install yourself, complete with filter, for \$1,395. If you don't feel up to digging the hole, you might get a contractor to do it for you for around \$80, or you can buy the pool installed for \$2,195.

The kit includes, besides the filtering system, side panels made of rotproofed wood, said to be good for 20 to 30 years, and a one-piece plastic liner the makers guarantee for 10 years.

The pool is named for Buster Crabbe, former noted swimmer and movie actor, and an officer of the manufacturing company, Cascade Pools Corp., Trenton, N. J.



**PLASTIC LINER** goes into the pool after the hole is dug, side walls are installed and sealed against moisture, the bottom roughly graded, and a load of sand spread over it and smoothed out.



**GLASS FILAMENT**—500 miles of it—is spun around rotating seamless steel tubes to make the shotgun barrels.

### Fiber-glass shotgun barrel

A new shotgun goes back to an old technique when barrels were wound with steel wire to make them stronger. Winchester-Western uses fiber-glass, however, which makes the barrel much lighter as well as stronger.

First comes a .02-inch thin-wall seamless steel tube around which 500 miles of glass filament is wound after passing through a resin bath. Glass and steel are next fused in an oven and the barrel wrapped tightly in a glass-cloth jacket with lengthwise fibers at right angles to those underneath to prevent whip. Then the barrel is impregnated with epoxy resin and oven-cured. A final step is grinding to finished contour.



**SHOTGUN IN ACTION**, at 6½-lb. weight, is easy to aim and fire.





**SOLID PLASTIC SHEET** lines the pool, pulled into place by suction from a vacuum cleaner. Shallow end is three feet, deep end seven.



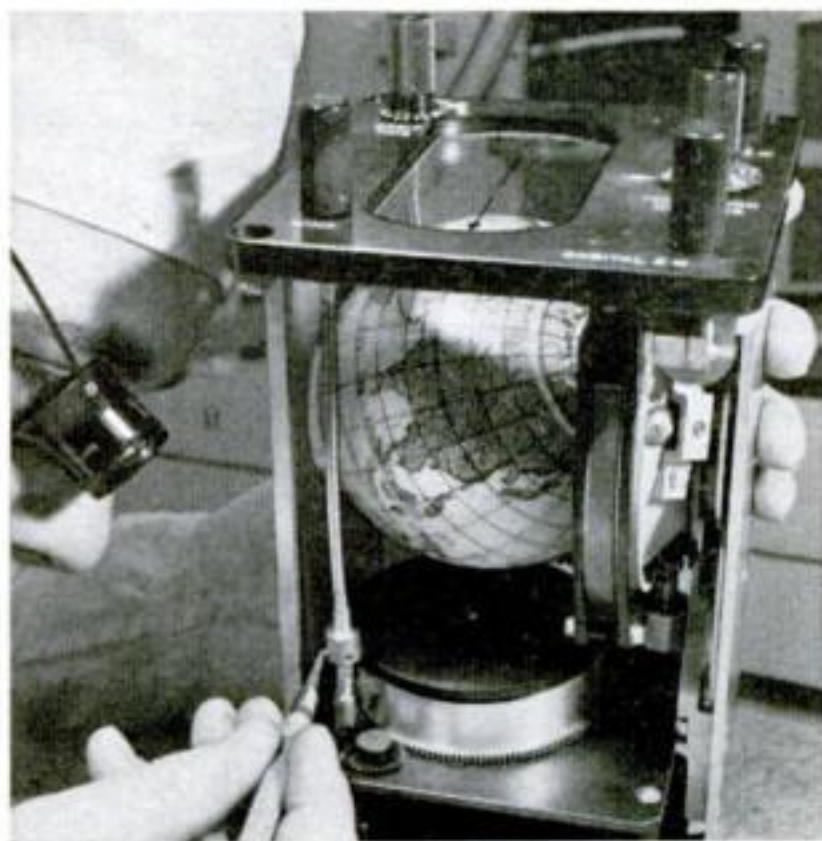
**COMPLETED POOL** is 16 by 32 feet, big enough for friends and neighbors as well as family. Owner of this one provided the walk himself.



### Sun-powered automobile

A 1912 Baker electric became a 1960 sun-powered model when engineers mounted a 26-square-foot panel on its roof. Its 10,000 silicon cells convert solar energy into electricity, charging the batteries fully in eight to ten hours of bright sunshine. The panel is tilted here to show the cells.

Called the Solar King, the roof panel is the largest of its kind yet made and would cost \$2,000 to \$3,000 mass-produced, according to the makers, International Rectifier Corp. of El Segundo, Calif.

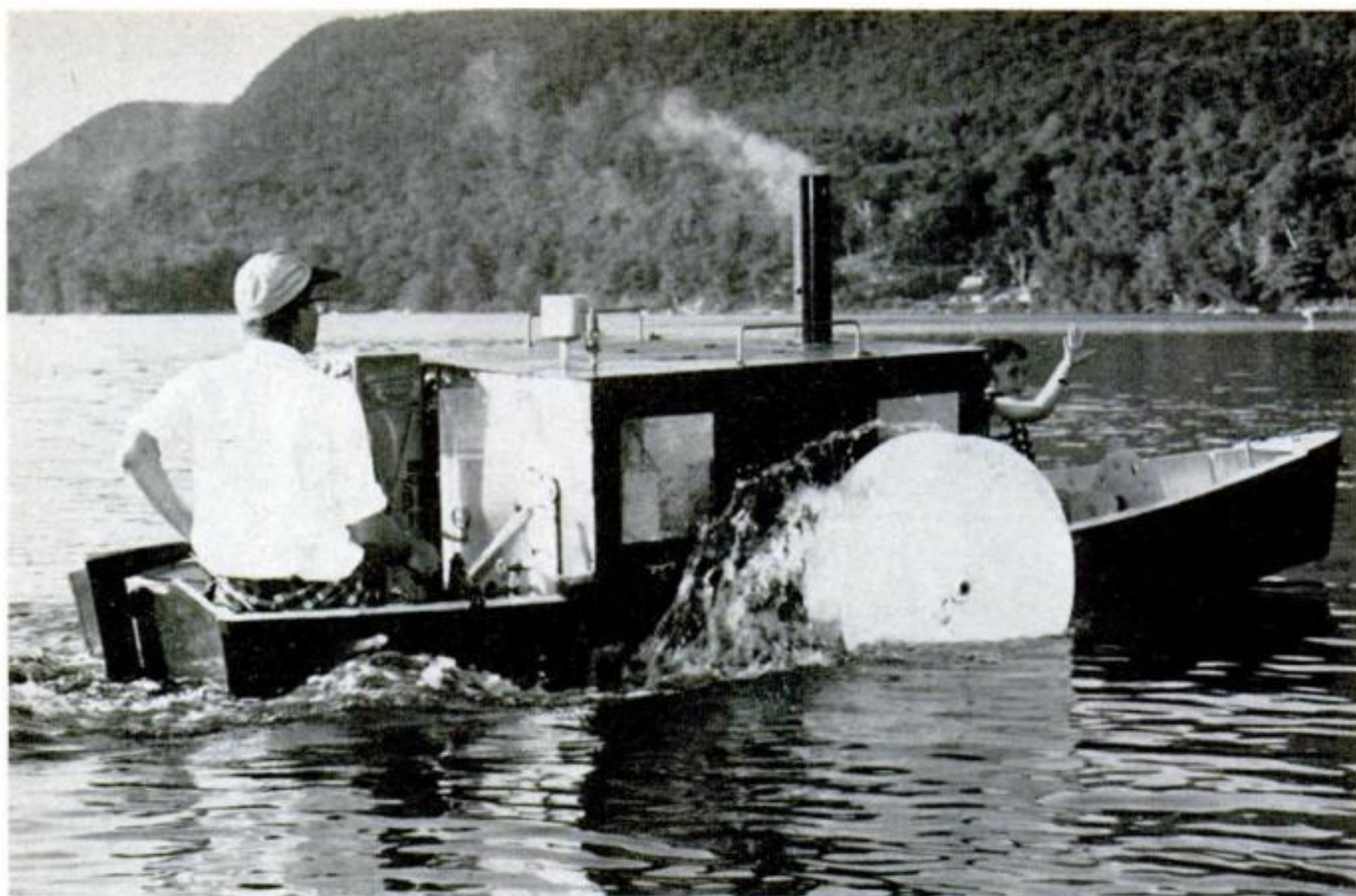


### Astronaut landing aid

A globe turning in this device would enable an orbiting spaceman to find his position over earth. It was designed by Minneapolis-Honeywell for Project Mercury to help an astronaut land his capsule safely if he should lose contact with ground-tracking stations on re-entry from space.

It has four adjustments to be set when the capsule reaches orbit, then operates mechanically, independent of the capsule's electrical system.



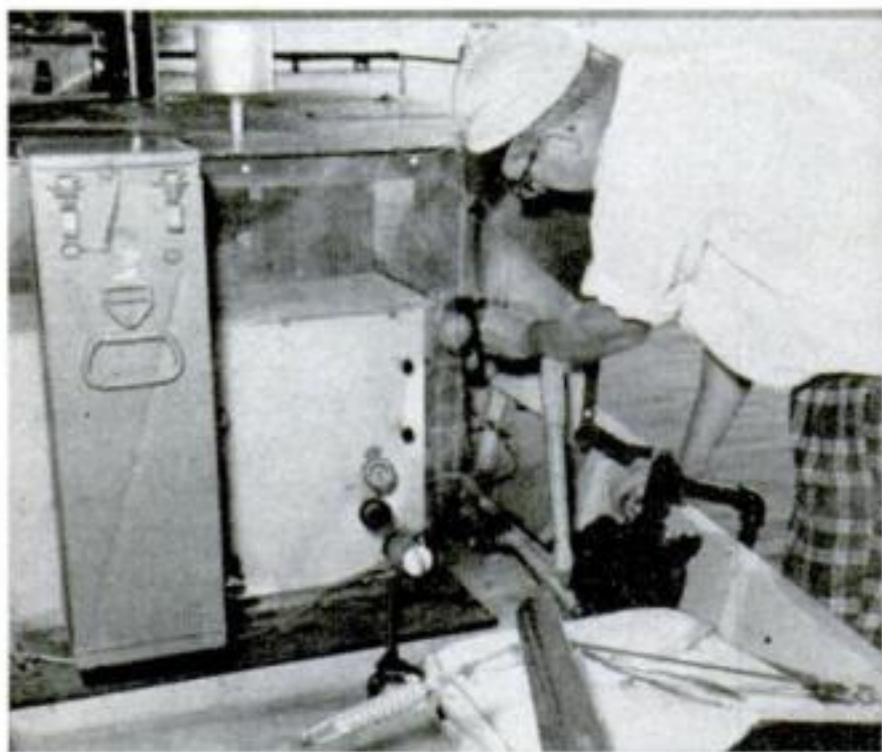


The pint-size side-wheeler makes its way across the lake with owner Kimberly at the helm.

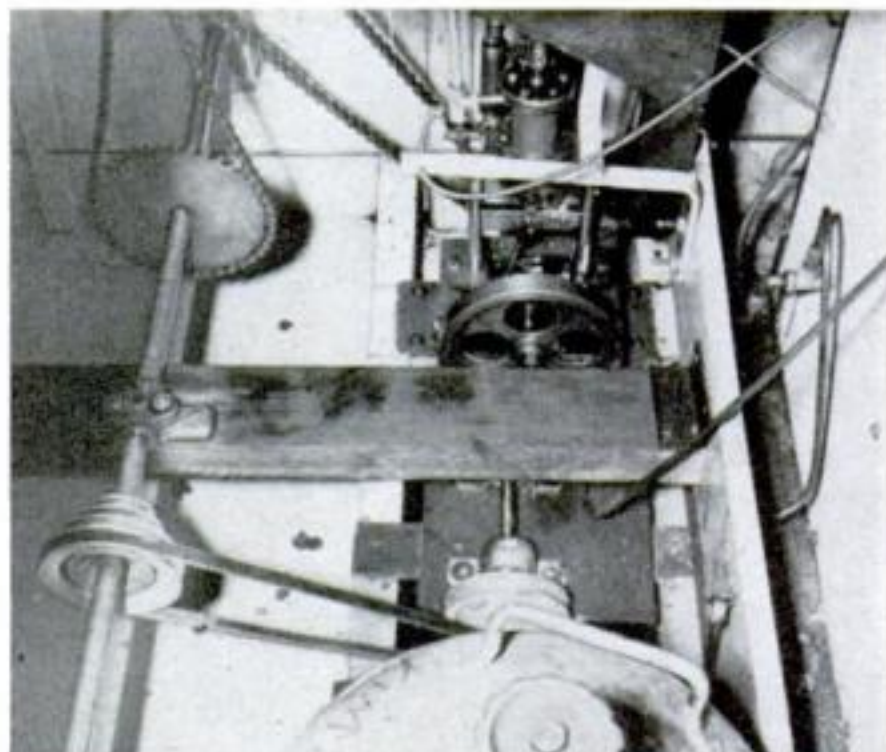
## Little Steamboat Runs on Bottled Gas

**"T**HE last side-wheeler steamboat on Lake Champlain" paddles along at six miles an hour with its boiler fired by cooking gas. The flat-bottomed boat with a one-cylinder steam engine was built by William R. Kimberly of Middlebury, Vt.

The boiler is a horizontal shell with small tubes welded on at the bottom. A surplus oxygen tank on top serves as the steam dome. At full speed the boat can operate for 10 hours on one 20-pound bottle of propane. It cost \$200.



**GETTING READY TO FIRE:** A pair of old oven burners gets the steam up to 90 pounds' pressure in four minutes. Box at center holds the boiler.



**"ENGINE-ROOM" VIEW** shows gas bottle at bottom, one-cylinder engine at top, and chain-sprocket transmission to paddle shaft at left.



**The stampede for compactness is on as Detroit prepares new small models, shortens and lightens others**

# What's Coming in 1961 Cars

**By Ken Fermoye**

*PS Detroit Editor*

**T**HINK small. That's the Detroit motto (by way of VW) for 1961. You'll see four new smaller-than-standard brands—plus shrunken versions of some of the biggest cars now on the market. (But prices? Big as ever.)

The passion for economy and smaller size is likely to put off engineering innovations such as trans-axles, indepen-

dent rear suspensions, V-6 engines, and air-oil springing.

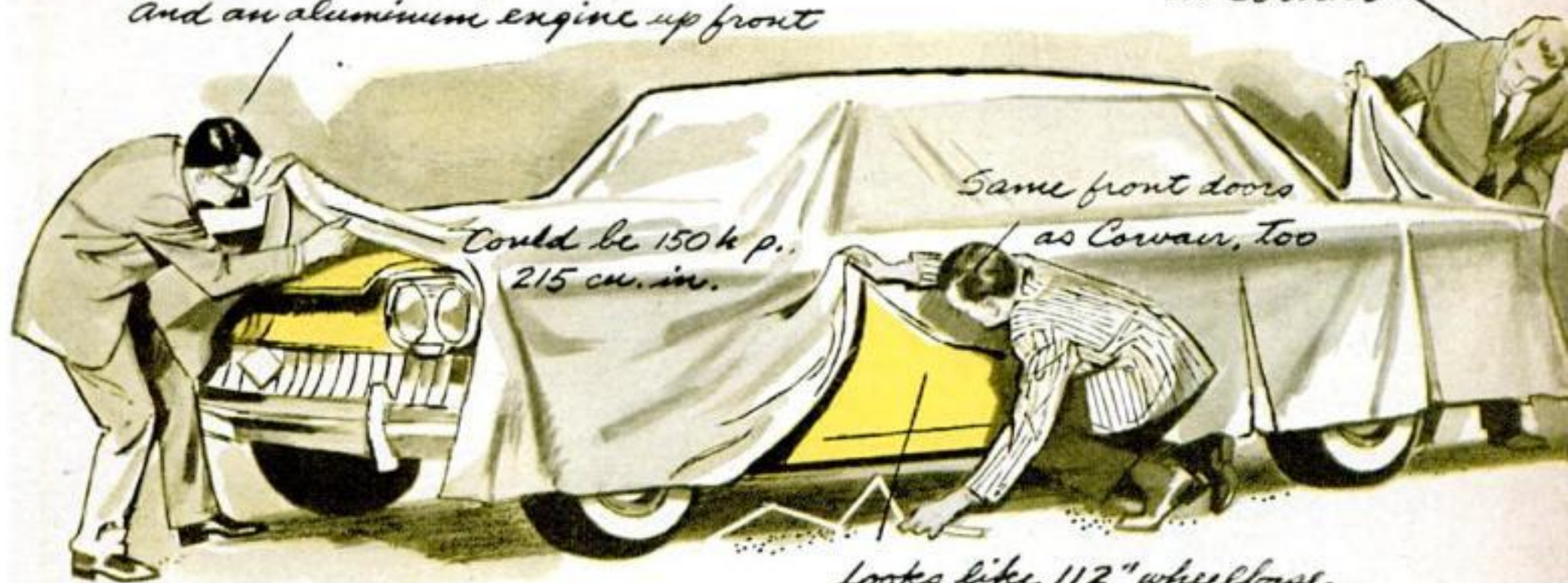
But the demand for light weight does mean brand-new engines—of aluminum. There'll be aluminum V-8s for two or three GM cars, an aluminum slant six in four Chrysler brands, and maybe an aluminum six for Rambler. Besides that, Pontiac may bring back the four-cylinder engine (but cast-iron).

Looks? You'll see lots of new shapes in the sheet metal, but no radical designs.

## **From General Motors: A new compact car that goes by three names**

*So that's the BOP car grille...  
And an aluminum engine up front*

*Same rear fenders  
as Corvair*



**T**HEY call it the BOP car in Detroit (because it will be sold by Buick, Oldsmobile, and Pontiac dealers). It's a direct descendant of Corvair (identical inner body panels, front doors, rear fenders, and other odd bits and pieces), though you'll have to be a certified automotive aficionado with a strong magnifying glass to tell it.

The BOP car is slightly less compact: 112-inch wheelbase, 190 to 195 inches overall, weight less than 2,800 pounds. The engine—up front—is the new V-8:

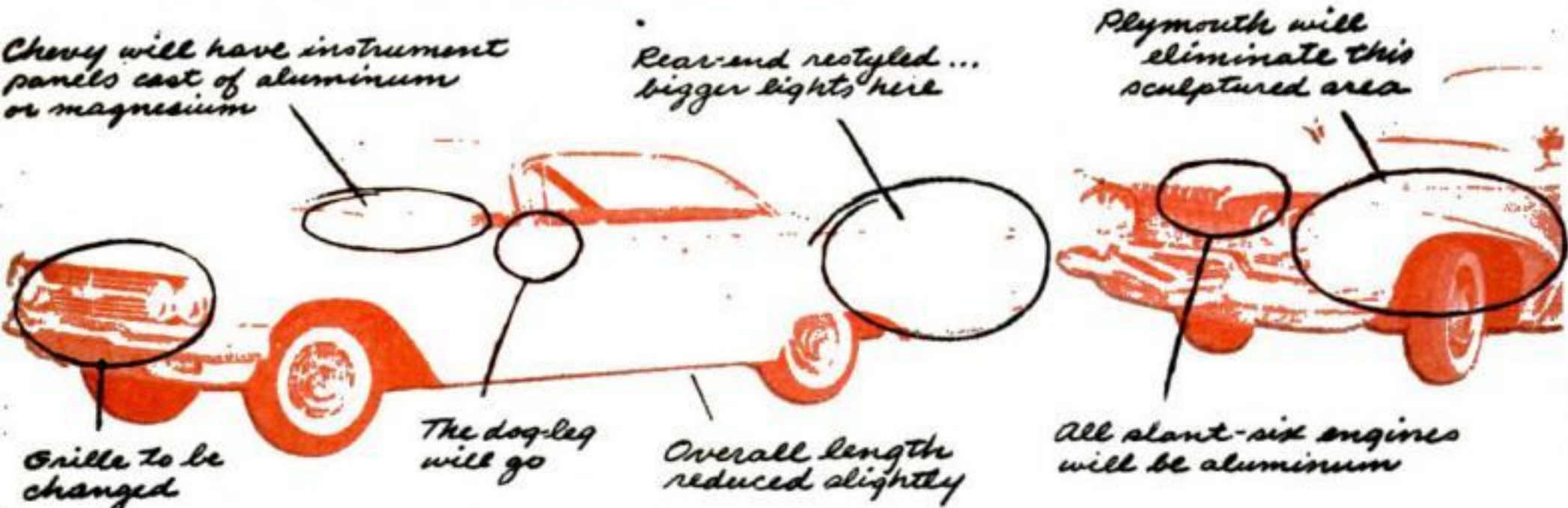
aluminum head and block, water-cooled, 3.5-inch bore by 2.5-inch stroke, 215-cu.-in. displacement. It should produce around 150 hp.

The new compact will appear under three names (most likely: Olds Rockette, Pontiac Tempest, Buick Special). And those clever, clever people at the Styling Center have worked their magic with accessories, trim, and modifications to make each of the three a distinctive, different-looking automobile. Even when you see them, you may not believe they're

CONTINUED



## How they'll change the Big Three for '61



so closely related to each other and Corvair.

The Tempest, which sports a fast back, may come with the four instead of the V-8 as its basic engine (to pare costs). The four-cylinder job would be half of the standard Pontiac's monster V-8, providing a generous 194.5 cu. in.

All the established brands will get major face-lifts. That nuisance, the dog-leg windshield pillar, will go. And, breaking away from the dogma of Complete Interchangeability so venerated in the BOP compact, GM will make new and individual roof panels, fenders, and other body parts. It'll be easier to tell a Chevy from a Pontiac from an Olds from a Buick.

GM engineers are pushing hard to get weight off their standard-size models. A big saving will come from one-piece castings of aluminum or magnesium for dash panels. These are destined for Chevy, and perhaps Buick and Olds. The rest of the weight is nibbled off here and



*...and 9 inches trimmed off the length*

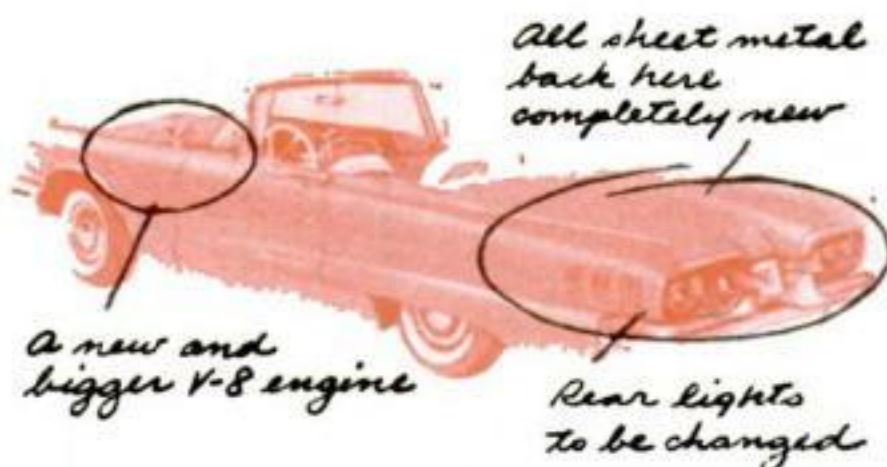
there. It all adds up: Some Chevy models are said to be 300 pounds lighter.

Cadillac will be a real surprise. At least one model, maybe all, of the rolling palaces will be nine inches shorter than current versions.

### From Ford: Jazzier T-Bird

**S**HARP restyling of the Thunderbird will make it sexier yet—with a long, Italianate snout, a roof line that slopes off rearward, and less angular rear-end treatment. There's an outside chance of front-wheel drive—and a price cut.

Ford and Mercury will get face-lifts to give them more than a passing resem-

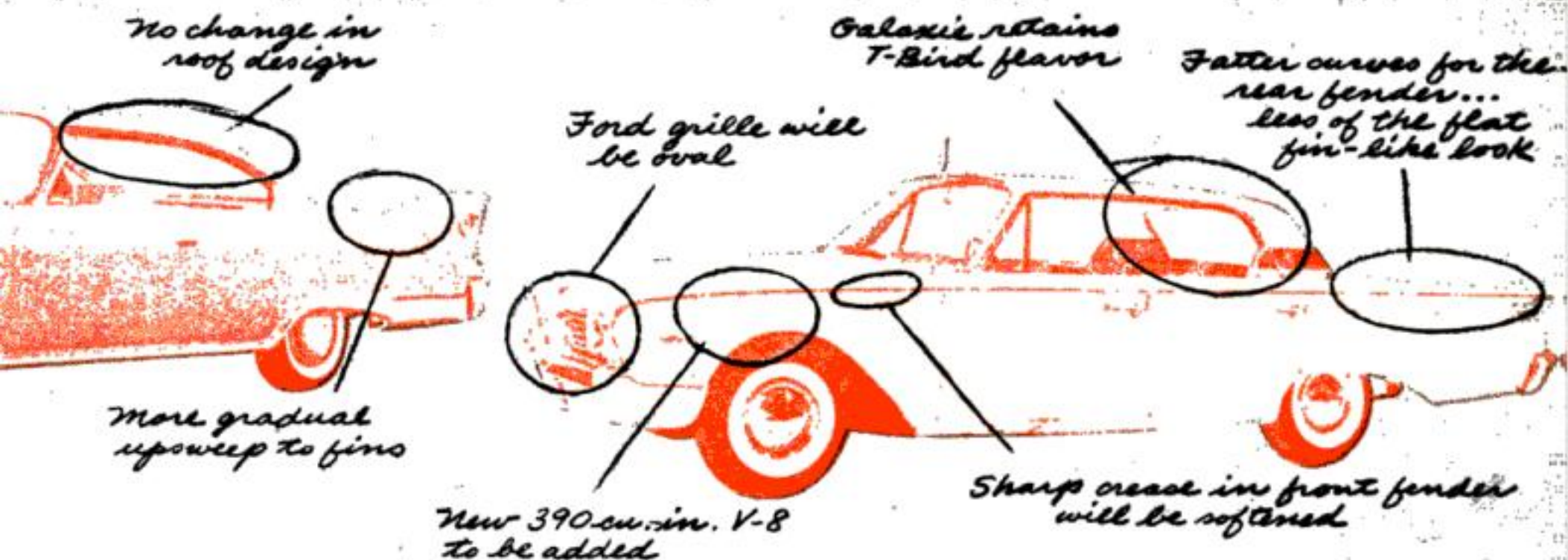


blance to the T-Bird. They'll share the same basic chassis and body (the two engineering staffs merged recently), but Merc will come out with a 120-inch wheelbase (vs. 119 for Ford) and a 217-inch overall length.

Some Ford models will come with a bigger V-8—390 cu. in. And 390-hp. versions of this engine—developing one horsepower for every cubic inch of displacement—will be offered as a limited option.

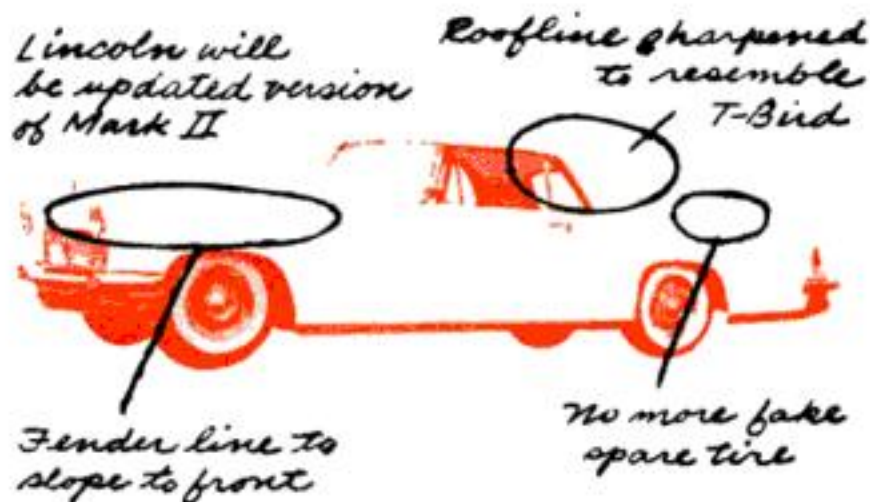
Comet is due for a huskier six-cylinder engine—170 cu. in., 105 hp.—but the styling chief told his men: "Just lift a few wrinkles." It will have a three-speed automatic transmission that could show up in the Falcon, too. Falcon may turn up as a convertible.





An intriguing Volkswagen-type Ford—but with front engine and front drive—is under development in Dearborn. However, it's far from ready.

At the other extreme, the long, long,



long Lincoln will be cut down eight inches in wheelbase (to 123) and 16 inches in overall length (to 211). It will look like a cross between a Continental Mark II and the current Thunderbird.

### From Chrysler: Sixes of aluminum

**D**ODGE, happy with its Dart, expects the new-for-1961 Lancer to attract still more customers. Lots of dies poured into Dodge's main plant this spring, indicating that Lancer won't be just a smudged carbon copy of Valiant.

The Chrysler slant-six engine will switch from a cast-iron to an aluminum block. Valiant and Dodge's Lancer will use a 170-cu.-in., 100-hp. version; Plymouth and Dart will have one-inch-higher blocks, for 225-cu. in. displacement and 150 hp. Aluminum V-8s are in the works, but not ready.

Some of Chrysler's hotter jobs are

overdue for better brakes and they're likely to get 'em. Not disks, but finned aluminum drums.

The alternating-current generators that appeared on Valiant and the big 300F will show up in the rest of the line. There'll also be more electroluminescent lighting for instrument panels.

### From Rambler: A restyled American

**Y**OU'LL see a more animated American for 1961, patterned on larger, current Ramblers. The wheelbase will be between 100 and 104 inches. And the regular Rambler will offer a convertible.

What will power 1961 Ramblers is the subject of much speculation. Rumor No. 1: Doehler-Jarvis (a big die-casting firm) is building dies for an aluminum V-6. Rumor No. 2: Doehler-Jarvis is making dies for an aluminum inline six with overhead valves. Rumor No. 3: Either Rumor No. 1 or No. 2 is correct, but for 1962 or 1963, not 1961. It'll definitely be a six.

### From Studebaker: An OHV six?

**S**TUDEBAKER-PACKARD, the last auto maker that does not offer an overhead-valve six-cylinder engine, may pull itself out of that rut by converting the old flathead. Other changes in Larks and Hawks will be limited to minor styling rearrangements and detail engineering improvements. As for those reports of a real Packard being reborn—forget them. If anything, the Hawk line might be dropped. Very few are sold.





## Bag of tricks

Your next trip to market will be a lucky one for your kids if the clerk packs your groceries in one of these wet-strength kraft-paper bags. They come printed with patterns showing where to cut and fold to make a pirate galleon, stern-wheeler, cabin cruiser, and—soon—other waterproof toys and household items. The new paper is fortified with American Cyana-mid's melamine resin, which makes bags tough enough to hold up under a leaky milk carton or soft, squashed tomato.

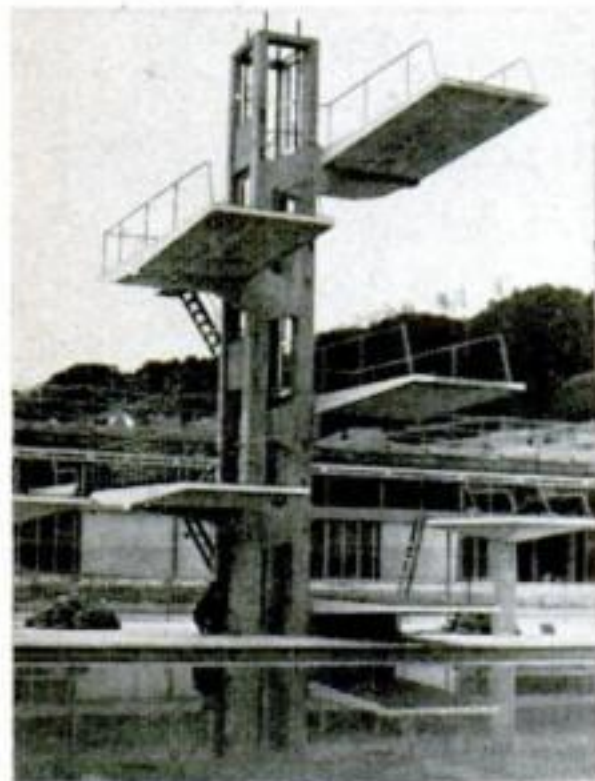


Gaudy patterns on new grocery sacks . . .

. . . make handsome, seaworthy toy boats.

## No-climb diving boards

An elevator in the center column will carry champion divers up to the boards on this tower in the Rome swimming stadium. The structure was built for the Olympic contests to be held in August and September.



## Artillerymen's six-shooter

This field-artillery weapon, the XM-70, fires its load of six 115-mm. shells in  $2\frac{1}{2}$  seconds. It is fed from a rotating cluster of chambers like a revolver. Ammunition is a combination of artillery shell and rocket. The rocket ignites after emerging from the barrel, boosts projectile range to 10 miles. The gun weighs 3,000 pounds, can be lifted by helicopter or towed by truck. The Army developed it for the Marines.

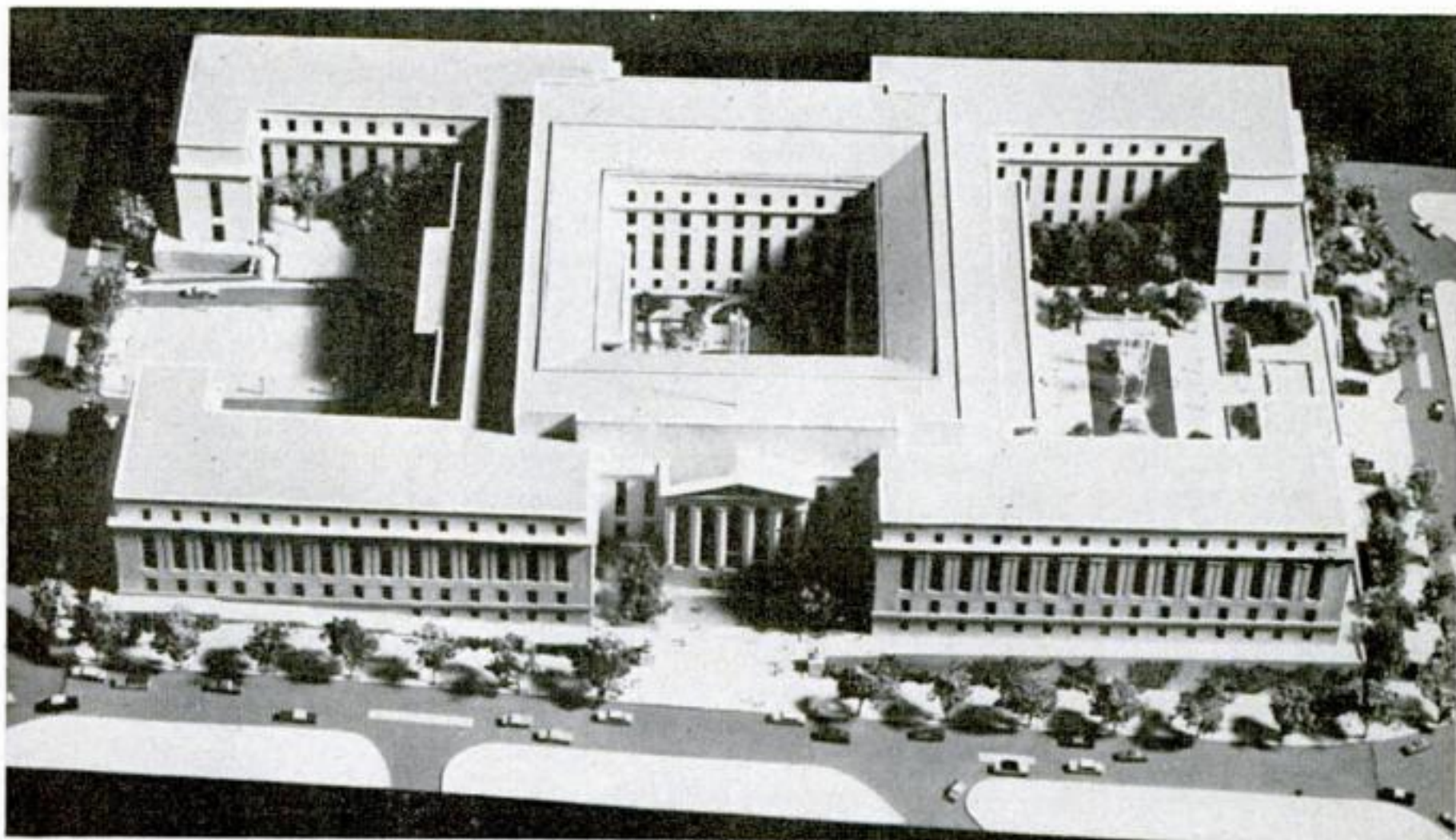


## Grounded capsule has space spin

The mock-up in the center of this triple cage is rigged to simulate a manned capsule in space. It is spun by spurts of nitrogen gas from jet nozzles, and can pitch, roll, and yaw.

The complicated machine was designed for NASA's research center at Cleveland to test pilots' reaction to disorienting motions and to train them to control simultaneous movement around three axes.

It can be operated by a lever in the pilot's right hand or by a scientist on the ground. A control at the left hand keeps the two in radio contact during "flight."



## Congressmen's new offices

Here's how the new House Office Building will look when it is completed three years from now. The \$66,000,000 struc-

ture will provide three-room suites for 169 Representatives, and also a number of committee and staff rooms. This model is now on display in the rotunda of the present House Office Building.





# Facts and Myths About

## **Statistics reveal some rather surprising facts about the lively state of matrimony**

**I**F YOU are an average bachelor you can expect to marry within a reasonable time and live happily ever after. If you are already married, the chances

that you will stick to your present wife are getting better every year.

That's what the statistics say. There will be exceptions, of course, but they will involve the other fellow, the one who always learns the hard way.

Is marriage popular? It certainly is. The odds at birth are that 92 out of every 100 males will marry sooner or later.

### **Are there enough girls?**

More than enough, and the figures indicate that men will find an even larger selection in the years ahead. During the next 10 years, the number of men will increase, but the fair sex will increase faster.

At present, the line-up is 100 females to 98 males in the age groups where marriage is most popular—18 to 23 for girls, 20 to 25 for men. By 1965, the ratio will increase to 100 to 95.

### **How soon will I marry?**

If you are an average unmarried American male aged 18 to 30, you can expect that within 10 years marriage—or death—will catch up with you. That do-or-die figure is called your “unmarried life expectancy.” It's at its lowest, 4.8 years, when you're 21. It stays low until you pass 30. At 31 your U.L.E. is 10.7 years, and rises steadily to 17.3 years for bachelors of 45.

### **Is marriage a healthier state?**

Seems so. Married persons have a far lower death rate than single or divorced persons. Among young unmarried males the death rate from pneumonia and influenza is several times greater than that

of the husbands in the same age group.

Violent deaths, too, take a far greater toll among the unmarried. The auto-accident death rate for widowers and divorced men, aged 20 to 44, is four times as high as for married men. Suicide is five times as frequent among divorced men as among married men, six times as frequent among widowers.

### **Are we marrying younger?**

We are, indeed. In 1950 the proportion of males 20 to 24 already married was twice that of 1900 and the curve is still rising. The female proportion is even greater. Why? Dr. Jacobson says: “Young people have the time, and the means, for frequent social contact. Thus they stand a better chance of meeting a desirable mate.”



*Frequent social contacts mean a better chance to meet a desirable mate.*





# Your Marriage By James T. Howard

Through age 27, the bachelor's chances of marrying remain about nine out of ten.

After that his hopes and/or fears subside rapidly. The odds drop to five in ten at age 39. But never say die. Among every 100 single men around at age 65, there will still be three who will pop the question.

These revealing facts about marriage

are from a new \$12 book, *American Marriage and Divorce*, by Dr. Paul H. Jacobson, a Metropolitan Life Insurance Co. statistician. It's published by Holt, Rinehart and Winston, 383 Madison Avenue, New York 17, N.Y. Dr. Jacobson and his staff spent years collecting and studying statistics. The facts they found answer some frequently asked questions:

## *But the overall marriage rate is declining, isn't it?*

Don't give it another thought. All it means is that things are balancing out after the postwar rush when the marriage curve tried to go through the top of the chart.

## *And isn't the divorce rate increasing?*

No. Headlines to the contrary, the divorce situation isn't nearly as bad as it seems. It's the isolated case that attracts attention. The wartime peak, in 1946, was 18 divorces per 1,000 marriages. But things are getting better. Today's rate is half that—about nine per 1,000.

Statistically, the first year of your marriage should be pure bliss. Divorces generally start occurring in the second year of marriage, mount throughout the third and fourth years.

If you survive the first four years, your chances of staying married are very good indeed. The divorce rate declines sharply thereafter.

## *"Once bitten, twice shy" is true, isn't it?*

Far from it. Divorcees remarry in droves. At age 25, 99 out of every 100

divorced persons will marry again, some to the same spouse. Divorced persons are more likely to marry than single persons. How soon? Among women, one-third re-



*Most divorced persons soon remarry.*

marry within a year, half within two years, two-thirds within five. Men hesitate awhile, but three out of five remarry within five years.

## *Are single men getting scarcer?*

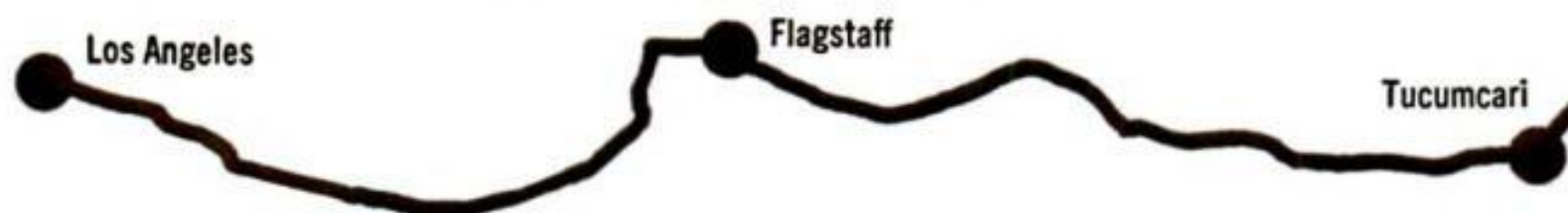
No question about it. Among males of 15 years and older the proportion of single men declined from 42 percent in 1890 to 33 percent in 1940 and to less than 25 percent in 1950. At 65, only nine percent of surviving males are still bachelors. But anything can happen—nine percent of over-65 ladies are single, too.





In New Mexico, winner hits 70. Route ranged from 22 feet below sea level to 7,270 above.

## Rambler American Sets Economy Mark in Compact Class



**T**HE Rambler American, unawed by new upstart compacts, averaged 28.3533 m.p.g. in the 2,061.4-mile 1960 Mobilgas Economy Run to win the Class A championship for the second year in a row.

Chrysler products dominated most other classes, taking four first and five second places. A Studebaker Hawk V-8 won in Class D, for low-medium price makes.

Ford and General Motors cars fared poorly. Thunderbird, Mercury, and Corvair took third place in their classes, and Cadillac was second in its class (with only two contenders).

The compact class aroused most interest and provided most surprises, though pre-Run handicappers figured the American—with a more powerful engine than last year, but made more efficient by use of overhead valves—for a strong contender. It had the lowest numerical axle ratio in the class, so its engine worked less at any given speed than any of the others. The Falcons looked promising, but seemed to require wider throttle open-

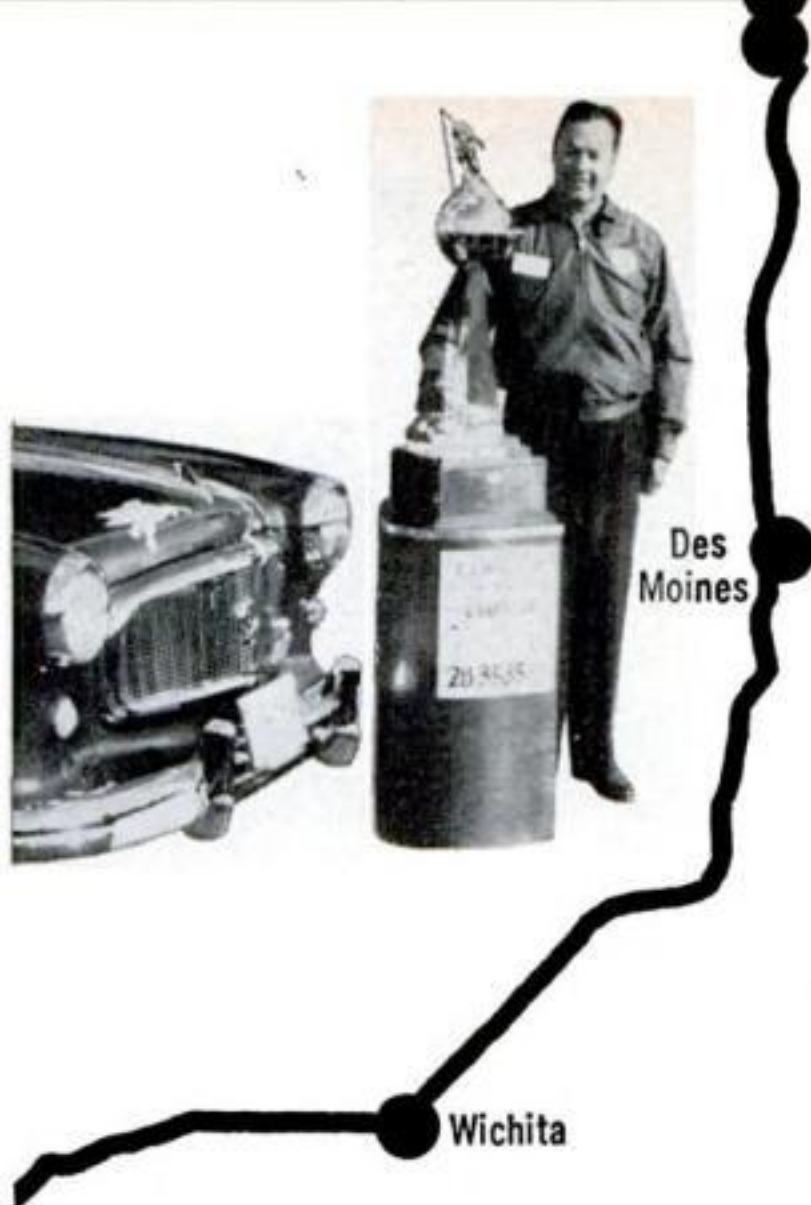
ings to maintain required speeds when bucking long grades or head winds. The Valiants, with their bigger, more powerful engines, did not have to work as hard. Nor did the Corvairs; their low silhouettes and small frontal area let them knife through head winds easily.

The usual gimmicks no average driver would bother about played their usual part in the 1960 Run. Sharp tuning put



**DRIVERS DON'T JUST SAY, "FILL 'ER UP."** Refueling is a precise and painstaking ritual.





**WINNER AND STILL CHAMPION:** Rambler American not only repeated its '59 triumph but bettered last year's mark by more than three m.p.g. Les Viland, standing beside the ornate Class A trophy, piloted the rugged six to victory with 28.35 m.p.g.

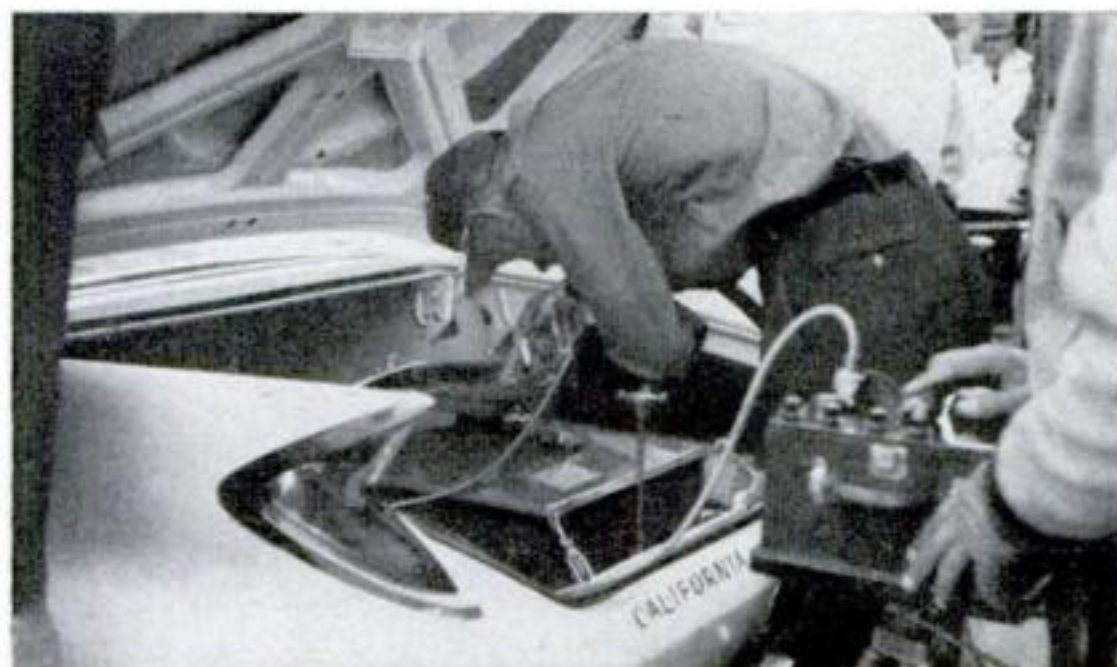
HOW THEY RAN IN 1960 (Listed in order of standing—first three cars only)		
COMPACT CARS	Driver	Miles per Gallon
RAMBLER AMERICAN CUSTOM	Les Viland	28.3533
VALIANT	Ginny Sims	27.2992
CORVAIR	Vince Piggins	27.0315
LOW-PRICE SIX CYLINDERS		
PLYMOUTH SAVOY SIX	Mary Hauser	24.8265
DODGE DART SIX	Woody Bell	24.7429
PLYMOUTH SAVOY SIX	Pierce Venable	24.7360
LOW-PRICE EIGHT CYLINDERS		
PLYMOUTH BELVEDERE EIGHT	Mary Davis	22.8899
PLYMOUTH BELVEDERE EIGHT	Jim Fosdick	22.5256
DODGE DART EIGHT	Lute Eldridge	22.2885
LOW-MEDIUM PRICE		
STUDEBAKER HAWK EIGHT	Jim Peterson	22.9899
DODGE MATADOR	Link Paola	21.1214
MERCURY MONTEREY	Byron Froelich	21.0696
UPPER-MEDIUM PRICE		
CHRYSLER NEW YORKER	Mel Alsbury Jr.	20.8715
DE SOTO ADVENTURER	Hart Fullerton	20.3627
THUNDERBIRD	Verne Houle	19.8912
HIGH PRICE		
IMPERIAL	George Alsbury	20.5036
CADILLAC	Pete Novotny	18.8170

the cars in perfect condition; stock, but with every part adjusted just right. Many cars ran their full allowable break-in period of 1,500 miles with lightweight break-in oil in the crankcase. Object: to promote faster wear and loosen engines up quickly.

Many teams had advance crews working. They ran each leg a day before the competing cars, timing traffic lights and

checking road conditions—then phoned back the information each night.

It's things like this, plus the economy-driving techniques of superbly skilled drivers, that make Economy Run mileage figures unrealistic in relation to the average driver. They merely indicate the *ultimate* economy potential of the various makes and give an idea of their relative m.p.g. miserliness.



**BLACK-BOX GIZMO** checks gas temperature; then allowances are made for variations in volume.



**WIRE SEALS** are placed on the special gas tanks used for the Run—and on trunk lids, too.



# The Most Dangerous Job at Canaveral

By Devon Francis



**DESTRUCT BOX** containing explosive is installed in a Cape Canaveral rocket next to a liquid-oxygen (lox) tank. Radio signal sets it off, to detonate lox and fuel.

**Crossing two wrong wires can be a fatal mistake for the men who load “destructs” on rockets**

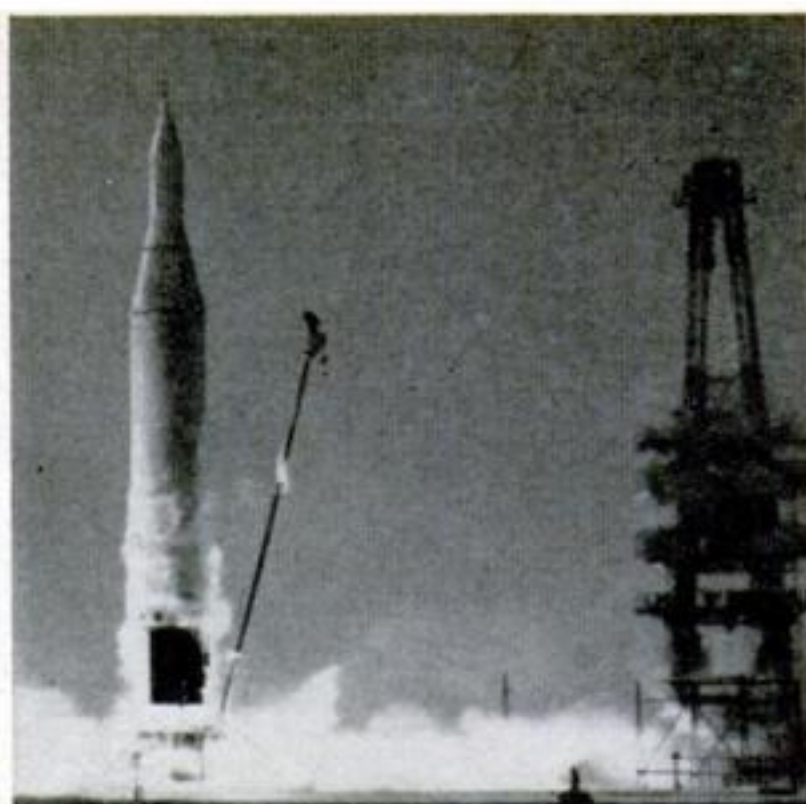
CAPE CANAVERAL, FLA.—In the blockhouse you can feel tension mounting. A half-dozen closed-circuit TV screens are reporting every activity on the huge concrete launching pad. Dozens of electrical sensors show temperature and pressure. A Navy-type periscope peers at the bird.

Its nose wears a plume of white—liquid oxygen boiling away. Two score men have groomed it for flight. Now, for safety, only a handful remain.

Just one task is left—the last human physical contact with the rocket.

On a screen you see two men crawl up alongside the bird's satin-smooth skin. They are on a lonely and ticklish mission—one of the most dangerous jobs in the world. It is also a morbid one: It anticipates failure.

These are the men who install the



**1. Rocket leaves pad . . .**



**4. Bird, a Juno II intended**





**2. Suddenly tilting, it goes wild . . . 3. Explosive charges rupture its tanks . . .**



**for earth orbit, dies in inferno as thousands of gallons of fuel and oxygen ignite.**

“destruct” mechanism that, on radioed command—the flipping of two toggle switches—will blow the bird apart if it fails to fly right. For a maverick rocket could explode in a schoolyard, in the center of a city, on a freighter at sea.

Once the men have installed the destroying charge, any rocket becomes a bomb.

The “destruct” is a blasting agent. Sometimes it’s in a box. One may be inserted into a cavity in a lox tank. Another goes into a cavity in the fuel tank. The

theory is that each tank can be ruptured and the bird brought to earth without fire. It never works. The bird always dies in an inferno.

Sometimes destruct men use primacord, a hollow cord filled with explosive. In this case, a slim, pencil-like ridge runs up the side of the bird to contain it.

Destructs have been put into birds ever since we began firing captured German V-2s at White Sands after World War II. They used to run primacord around the bird’s midsection like a belt.



## Placing explosive in rocket tanks takes men nervy enough

The powder in the destructs is, in itself, dangerous enough. But it's the thousands of gallons of fuel and oxidizer in the rocket that require destruct men who are nerveless enough to spit in the bright face of death.

**No margin for error.** There are dozens of possibilities of a fatal mistake. Cross the wrong two wires, and the destruct installers could set off the bomb. Only a few months ago an Air Force intercontinental ballistic missile blew up on its launching pad the moment the engines started. The destruct system had been wired wrong.

Mishaps like these spur rocket men on to almost interminable checking and re-checking. A visiting Air Force sergeant once watched while destruct men were arming a bird that was fueled and ready to fly. They kept inserting things in the maze of wiring in the destruct box and then pulling them out.

"Look like fuses," commented the sergeant idly.

"They are," said one of the destruct men. "We're blowing a dozen or so to be sure the circuits are working."

White-faced, the sergeant almost had to be helped from the elevator at pad level.

Yet Cape Canaveral has an incredibly good safety record. Not once, in the more than 10 years of launchings at this experimental rocket site, has anybody been killed in an accident even remotely associated with fueling, firing, or destruction of a bird.

This is more than just good luck. The reason lies in an elaborate, inviolable safety code.

- **Item:** The destruct system must be disarmed whenever the countdown is stopped. If a technician must mount the gantry to investigate trouble, he first removes a bit of wire from the destruct circuit. He puts this in his pocket. It's his life insurance.

- **Item:** Once a destruct system has been installed, not one single radio transmission is permitted on the Cape.

All electrical contacts between the bird, the blockhouse sheltering the launch personnel, and Central Control at Cape headquarters, are by cable. Nobody has ever proved that a random radio



**SAMPLE OF LOX** is drawn off by technician at base of Titan gantry. Specially treated cotton clothing wards off burns if the lox spills.



**HARD-HATTED ATTENDANTS** swing door on Atlas blockhouse shut. It weighs six tons, is eight feet high, seven feet wide, eight inches thick.



## to spit in the face of death

transmission—like that from an automobile, for instance—has set off a destruct. But Canaveral takes no chances.

● **Item:** A destruct command can issue only from one point, Central Control.

There, for safety, the console of switches contains two toggle switches, protected by plastic hoods that have to be pushed back before an operator's fingers can reach them.

Both switches must be thrown to complete the job on the bird. For safety, there is a stand-by circuit on a different frequency if the first circuit fails.

Both frequencies are, of course, secret to prevent the destruction of a bird by sabotage. As an added precaution against the possibility of malicious destruction, the radio signal frequently is coded.

**The quick fix.** Flirting with the danger of malfunctions is a commonplace at Canaveral. So is the improvised fix.

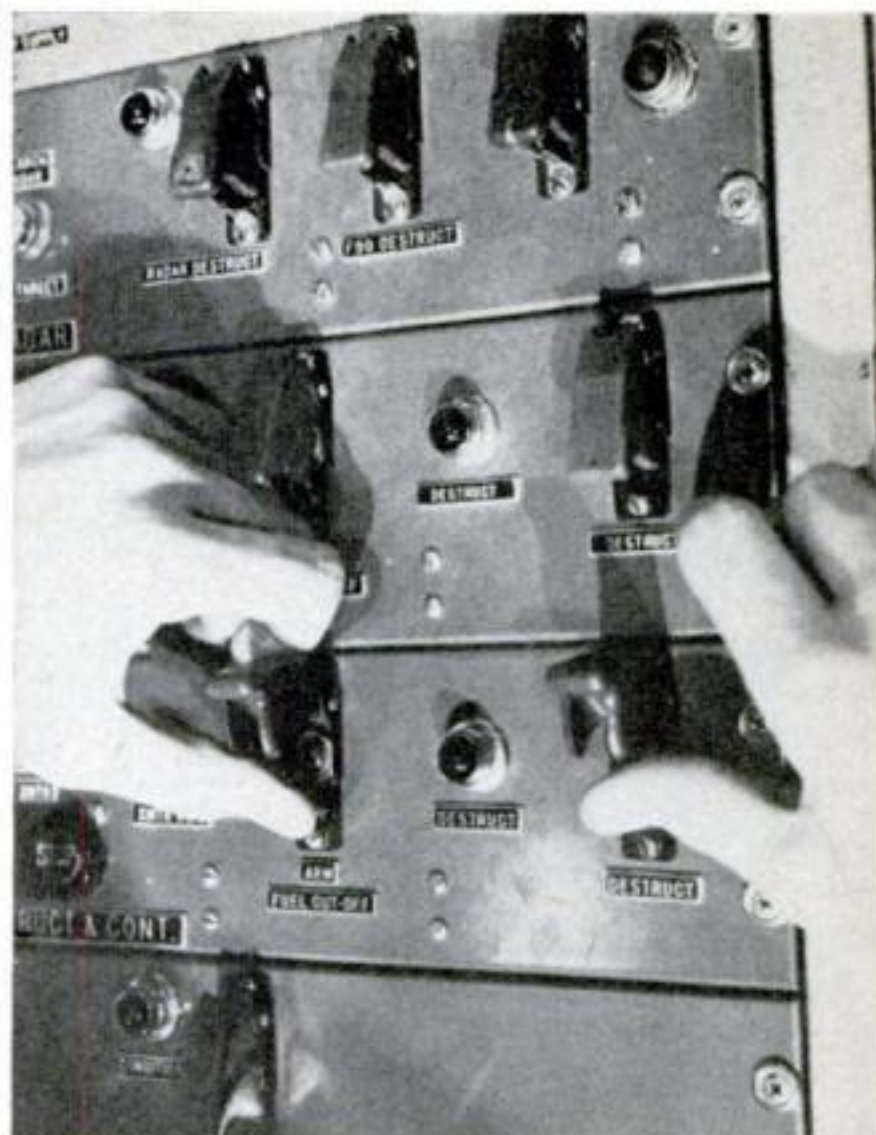
Last September a Project Vanguard rocket, built by the Martin Company, reached T-zero in the long countdown. The engines refused to ignite.

With all electrical circuits disconnected, a safety crew swung open the blockhouse door and ran to the launch pad.

First, the destruct system, as always, was disarmed. Probing, the technicians turned up a broken wire inside a switch on one of the engine controls. The mend was simple.

But then a transducer, a device that measured the kerosene inlet pressure to the first-stage fuel pump, was found to be ailing. Replacing it would necessitate draining all the fuel from the first- and second-stage tanks. The only alternative, to get at the transducer, was to break a small, secondary fuel line. This would be dangerous—there'd be kerosene spewing from that line.

Leonard Arnowitz, chief of Martin's Vanguard engineers at the Cape, called for kitchen foil and a bunch of diapers. A technician built a basin with the foil,



**TO DESTROY A BIRD**, range safety officer throws toggle switch (left) arming the system and cutting off fuel. His right thumb ignites charge. The stand-by toggle switch is just above.

and lined it with diapers. He positioned his basin under the fuel line.

He broke the line, held the flow with his thumb while he devised a cap, replaced the transducer, calibrated it, purged the system with a shot of nitrogen, and reconnected the fuel line.

Total loss of fuel into the diapers: one pint.

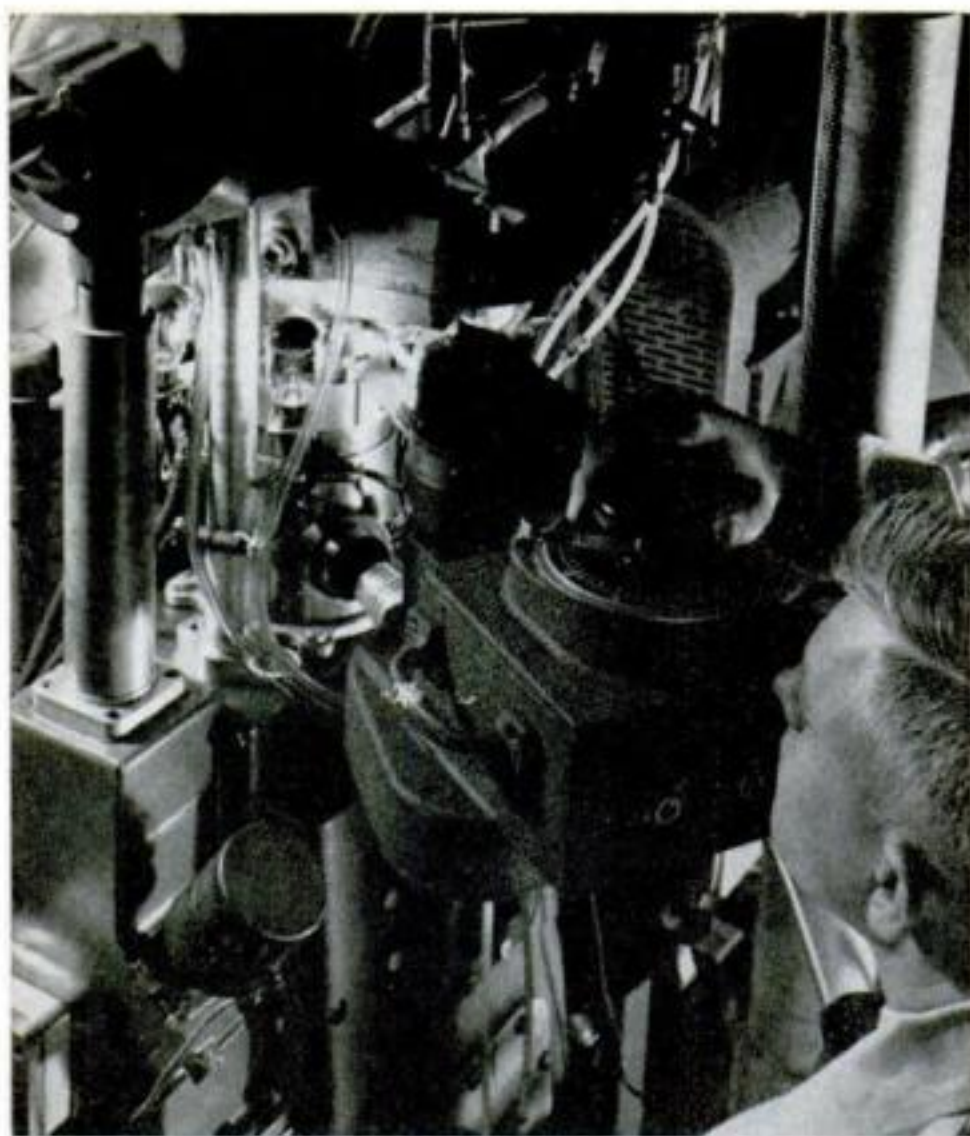
Launched perfectly, the Vanguard put a satellite into orbit. It's still up there, circling the earth.

Even the world's most dangerous jobs can have their laughs. On one rocket malfunction during countdown at Canaveral the loudspeaker suddenly blared: "All personnel take cover!" A nurse, standing by with the customary medical detachment, dived under a truck. When the emergency was over, she crawled out—to discover that she had taken refuge under a ton of explosives.

## Next Month: A Monster Robot Called Solaris

*It will probe the ocean depths with an arm 2,000 feet long, TV-camera eyes, and a claw that can clamp onto a 2½-ton load. One of the weirdest contraptions ever devised, Solaris will be fully pictured and described in July PS.*





**CAMERA AT WINDOW** takes photos inside cylinder. High-intensity lamps mounted on the engine provide light through a transparent collar under the head.



**CUTAWAY VIEW** of the piston, cylinder, and cylinder-head assembly shows slot through which the stationary camera window extends. Mirror is attached to window housing.

## Peephole piston shows how engine fires

An unusual quartz-top piston lets GM engineers take a photographic look-see at the process of combustion inside

overhead-valve auto engines. Shooting through the transparent piston crown, they get high-speed sequence photo-



### Theater has rotating audience

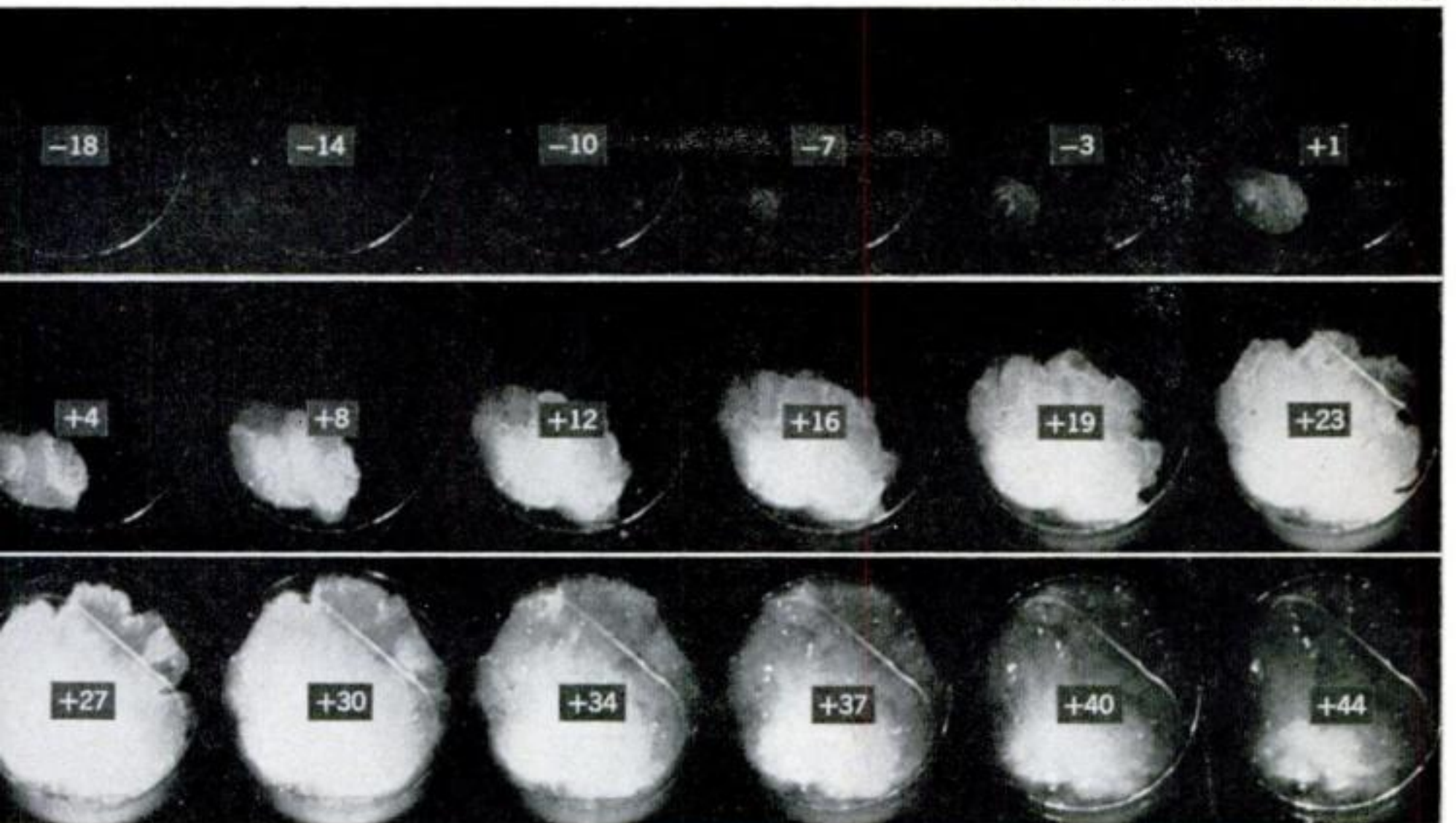
The seats of this outdoor theater at Tampere, Finland, are in a stand on a turntable. Instead of having the scenery shifted on a single stage, separate sets are built in a circle around the bowl. At the end of each act, the audience is revolved to face the next scene.



### Bottle spinner

In one phase of champagne making in California, this workman has to turn each of these bottles once a day for three months. They are kept neck down in racks, and the process settles yeast sediment that is drawn off to leave clear champagne.





**FIRING CYCLE** reveals spark discharge when the crank angle is 14 degrees before top center.

Combustion is complete after the explosion when the angle is 37 degrees after top center.

graphs in color of the burning of air and fuel. The see-through piston is assembled in a special single-cylinder laboratory engine, using compression ratios as high as 10.7:1. A slotted side on the piston

gives the camera a view of the combustion chamber from the bottom through a window and mirror. A transparent collar between the cylinder and head admits light, adding to that from the explosion.



### Telephones on wheels

The mobile telephone center above has been put into service in Chicago. It is designed to assist reporters and officials at special events. The 32-foot bus carries 15 phones—two of them on the outside. It is also provided with 10 mobile radio-telephone channels, several hand-carried radio transmitters, and a powerful public-address system.



### Floating garage

When the USS Essex moved its base from Mayport, Fla., to Quonset Point, R.I., officers and men who owned cars received permission to transport them on the carrier's flight deck. One catch—a warning: If war broke out while they were at sea, the cars would be dumped. The ship carried no planes, as a new flying group will be attached in Rhode Island.



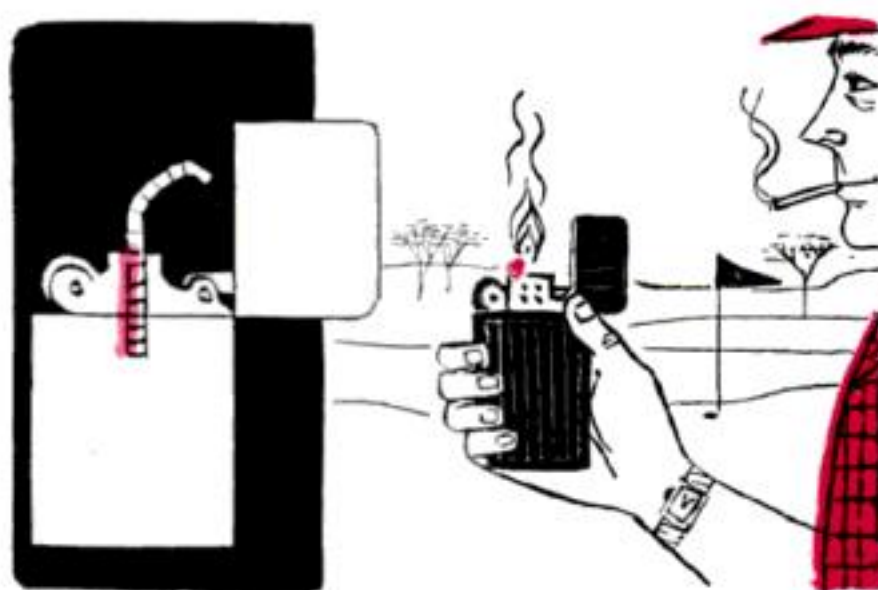
# "I'd like to see them make..."



**EASY-ROLL BOAT TRAILERS** and outboard carriers on Rolygon air-bag tires. They'd handle more easily on rough terrain than wheeled ones.—*R. W. Schiller, Menominee, Mich.*



**SOFT-PLASTIC MILK CARTONS** so you'd never get clumps of wax in a glass of milk. And you'd never get leaks in the nonbreakable containers, either.—*R. H. Morgan, Towaco, N. J.*



**REPLACEMENT-SIGNALING WICKS** for cigarette lighters. Why not dye the last inch a bright color, or simply interweave several colored threads?—*J. J. Vernimmen, Grand Rapids, Mich.*



**A LIGHT PICNIC TRAILER** on two wheels. You could jockey it around by hand at the picnic site and the cover would open out to make it a table.—*R. A. Reynolds, Westbrook, Maine.*



**A PULL-OUT SUN VISOR** over a car windshield. It would stretch across to fill the gap and shade a middle passenger from bright sun.—*Richard Bauguess, Fort Worth, Tex.*

Everyone has his own pet idea of a gadget that he would like to see in general use. The five ideas illustrated above were suggested by POPULAR SCIENCE readers. What's

yours? We will pay \$5 for each one published. Please use Government postcards only. Write name and address clearly. Contributions cannot be acknowledged or returned.





**PANIC STOP FROM 60 M.P.H.** sends smoke pouring from the Chevrolet's tires as they slide

along the asphalt. One stop like this can wear a flat spot on tires and ruin a whole set.

**Floor the throttle to 115 . . . take a turn at 75 . . . hit the brake at 90—that's the punishment L. A. cops hand out when they're—**



## **Torture-Testing Cars for Police Patrol**

**By Bill Carroll**

**T**ESTING 1960's typical police cars begins this foggy morning on the 2.1 miles of race track at the Los Angeles county fair grounds. Up for evaluation are Plymouth, Dart, Dodge, Chevrolet, Pontiac, Ford. Lt. Ron Root of the Pomona police department and Officer Gordon Browning of Los Angeles stand ready to put the first samples through the wringer.

First a Dart warily circles the course to be sure it is unobstructed. Three warm-

**EXTRA-WIDE BRAKE DRUMS AND LININGS** on the specially prepared Fords were wiped clean before the tests. The car was then driven around the track to cool the brakes in moving air.

CONTINUED

75







**TIGHT TURN AT 65 M.P.H.** tilts this softly sprung sedan. Note how the load thrown to the outside

front wheel lifts the inside wheels almost off the ground, making handling difficult.

up laps follow. Then Browning signals for "time" to be taken. The first lap is moderately fast, the second, third, and fourth progressively faster. Average time: 1 minute 43 seconds for a 2.1-mile lap.

Root takes the Dart next. From a standstill he crosses the quarter-mile timing line at 80 m.p.h., reaches 115 on the 0.7-mile straight, brakes to 75 for the first sweeping left turn and to 60 for a right-angle bend, slams into second gear for a dangerous reverse left under a bridge. Full throttle now, rear wheels biting deep to burn rubber around a rough left at 75 and ease right between too-close telephone poles. Then up to 90 on the short back straight, brake again, drift right over a spring-bending hump, hold 80 around a sweeping "U." The short straight is good for 100; brake to 65 for Turn 11 and again up to 100—110—115 on the long straight. Brake to 75 and start another lap.

In seven minutes the Dart finishes four laps. Average time for both officers: 1 minute 44 seconds—72.2 m.p.h.

Then a Plymouth rips around the road-ability course, each officer making warm-

up laps before the test run. They average 1 minute 43 seconds, or 73.0 m.p.h. (Good sports-car speed, same track: 80 m.p.h.)

**Dart brake tests next.** From 90 m.p.h., stop as quickly as possible without sliding a wheel. Stand for two minutes so drum and lining "heat soak" to maximum temperature. Up to 90. Stop again. Stand two minutes more while brake temperatures skyrocket. Four of these 90-mile-an-hour stops, then a panic stop. From 60 miles an hour, brake hard. All four wheels lock, tires sliding far and fast.

Rear wheels of the Dart skip and shudder. The tires ride onto an oil slick and the sedan slews sideways, then stops with tires and pavement smoking from abuse. The decision: "Severe rear-wheel bounce." Skid marks are measured while the car rests for five minutes of brake cooling. The series of stops—four 90-m.p.h. and one panic—is repeated. On the last panic test, Dart's rear wheels stay on the ground.

Now Plymouth. Up to 90 and stop. Up to 90 and stop. Four times. Brakes hot enough to burn timber. A panic stop. The lighter Plymouth, with heavy-duty



**WIDE-TRACK PONTIAC** cornered with very little body lean. It and Dodge were rated equally good in turns by the police drivers who tested them.





**SKID MARKS SHOW** how a car with standard suspension (left) can drift sideways in a panic



stop. Heavy-duty suspension on a Pontiac police model (right) produced straight-line stop.

springs, comes down straight as a die.

There's a good reason for this extreme, brake-punishing test. "The Los Angeles police department averages 20 citations a week for speeding over 100 m.p.h.," says Lt. Don Mann of Traffic. "That's why we believe the world's best patrol car is no better than its brakes."

**Pontiac and Chevrolet** have police samples at the track two days later. The Pontiac's big V-8 churns around the track at sports-car speeds—77.1 m.p.h. It's okay. Then Chevrolet. Neither Browning nor Root are comfortable about the way it handles in driving or brake tests. The Chevy representative agrees to have the suspension checked and return the car.

Now Ford, also seriously interested in selling 303 new patrol cars to Los Angeles, has its turn. But like Chevrolet's first sample, the Ford does not handle too well in roadability runs. Rear wheels are light in fast corners.

In brake tests with the Ford sedan the sudden transfer of weight to front wheels during panic stops has rear wheels skipping three or four feet at a time. Hood and fenders develop metal-rattling shud-

ders heard a hundred feet away. After brakes wear in, though, and with lighter pedal pressure, shuddering slacks off. Ford qualifies.

**Retesting the Chevy.** Three days later Chevrolet shows up again. They had checked suspension and found that the springs were not heavy-duty as specified and that they differed in stiffness. A production-line goof. Again Chevrolet is wrung out by Browning and Root. This time it's acceptable for bidding. Now police mechanics impound the Chevy's brake shoes, as they have with the shoes of the other test cars. The reason: to make sure that the same lining material is supplied with any cars bought.

Why does Los Angeles test prospective police cars? The answer is safety. The testers recall one car with tires that rolled under so far on high-speed corners that sidewall lettering scuffed off. Another broke a wheel after sliding a corner at high speed, and one broke a front spindle and rode down from 100 m.p.h. on a brake drum. And there was a parking brake that worked so well it snapped a universal joint when yanked on.

**SMOKE** here isn't from braking. This Dodge was driven so hard on right turns that unloaded wheel spun under power. The tire lasted only 50 miles.





# How a Truck Scale

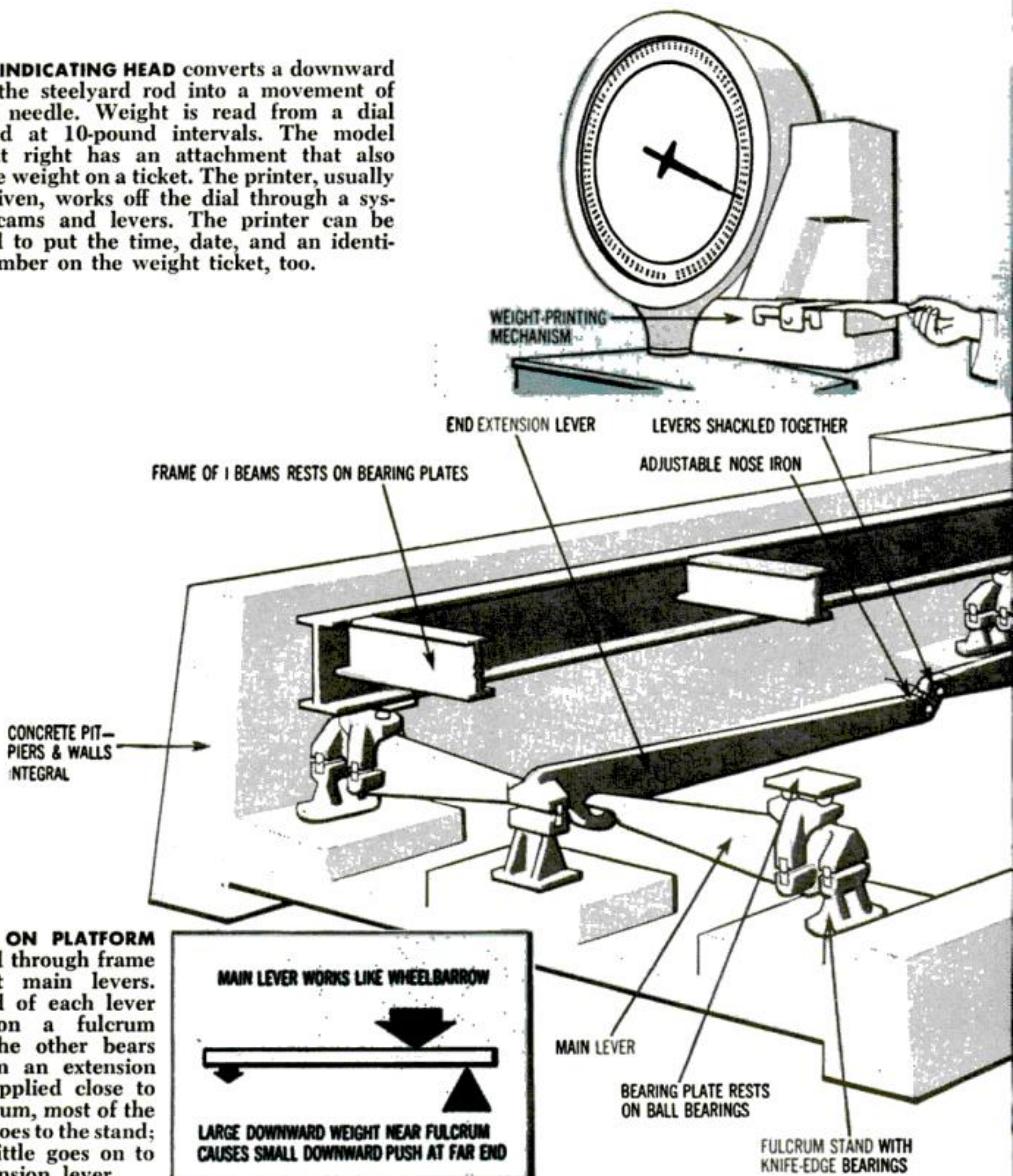
**T**HE platform scales that weigh trucks work on the same principle as the personal scales that weigh you in your doctor's office. Both have levers that divide the weight, balancing many pounds on the platform with one pound at the indicator mechanism.

A 50-ton Howe truck scale like the

one illustrated here has four pairs of main levers, so linked that 7,000 pounds on the platform exert a one-pound force at the indicator. Your doctor's scale, using one pair of levers, has a 40:1 "tip ratio."

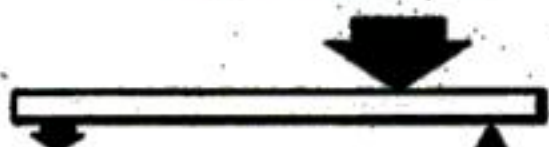
Hardware for a 50-ton truck scale costs about \$6,500.—*Erik H. Arctander.*

**WEIGHT-INDICATING HEAD** converts a downward pull on the steelyard rod into a movement of the dial needle. Weight is read from a dial numbered at 10-pound intervals. The model shown at right has an attachment that also prints the weight on a ticket. The printer, usually motor-driven, works off the dial through a system of cams and levers. The printer can be equipped to put the time, date, and an identifying number on the weight ticket, too.



**WEIGHT ON PLATFORM** is passed through frame to eight main levers. One end of each lever pivots on a fulcrum stand, the other bears down on an extension lever. Applied close to the fulcrum, most of the weight goes to the stand; only a little goes on to the extension lever.

**MAIN LEVER WORKS LIKE WHEELBARROW**

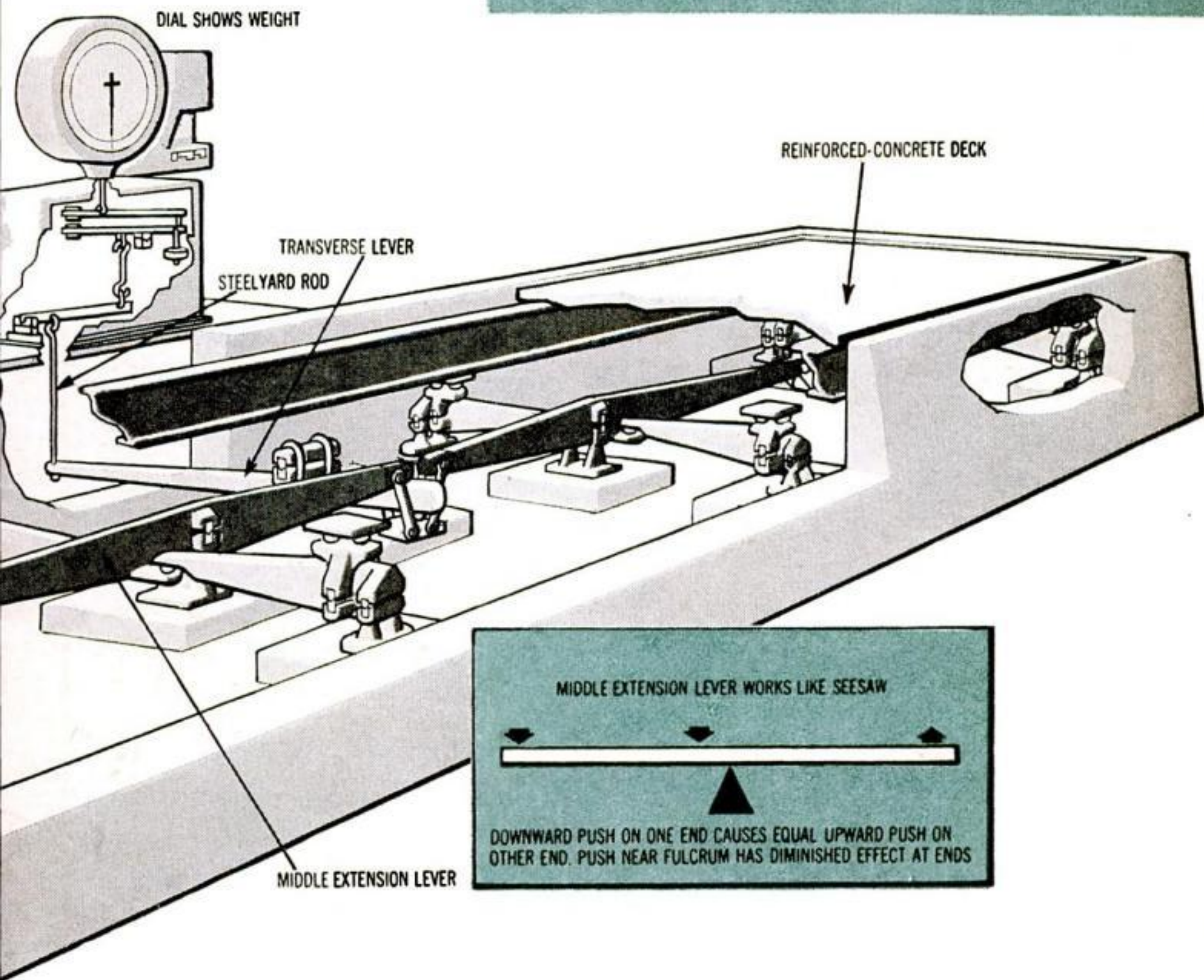
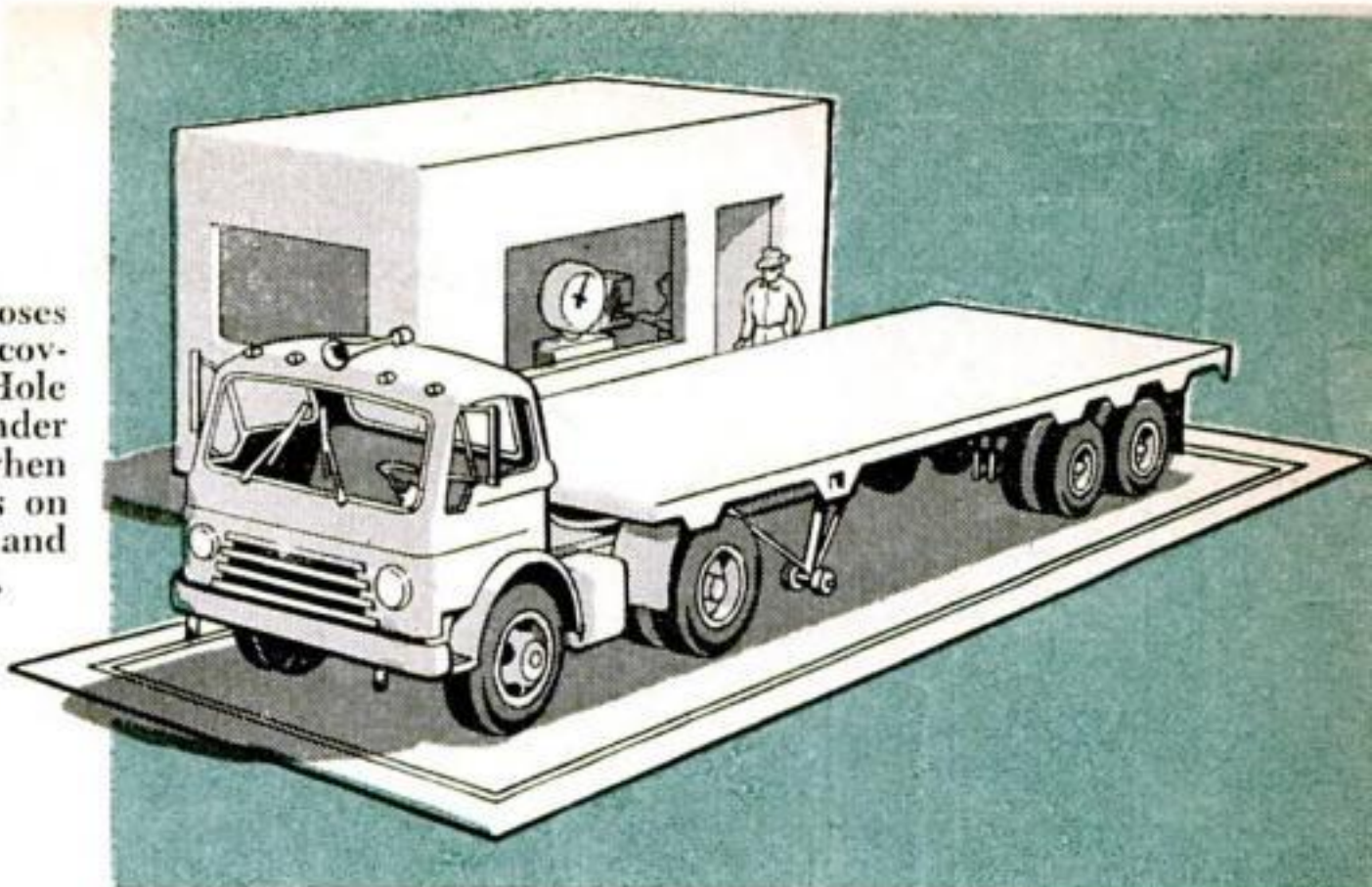


**LARGE DOWNWARD WEIGHT NEAR FULCRUM CAUSES SMALL DOWNWARD PUSH AT FAR END**



# Works

**WEIGH-STATION BUILDING** encloses the indicator mechanism and covers an access hole to the pit. Hole allows mechanics to crawl under platform and adjust nose irons when scale loses accuracy. Platforms on 50-ton scales are 10 feet wide and come 45, 50, and 60 feet long.



**THE FOUR EXTENSION LEVERS**, tipped by main levers resting on them, apply a combined upward pull on the transverse lever. This lever pivots, pulling down the steelyard rod. The rod then actuates the indicator head.

In the course of being shifted from platform

to steelyard rod, the weight is divided at each step by the levers. Most of it is absorbed by the lever stands and only a small part is passed on. At the indicator head, only one pound for every 7,000 pounds on the platform is left to move the dial's needle to give the reading.





High brick wall and overhanging steel roof shade the patio.

## Skeleton of curved steel supports unique house



**FRAMING OVER THE CARPORT** is anchored to reinforced buttresses, which take the shear load.



Concrete for the rough slab was

A man who used to work on an aircraft production line has built an unusual, steel-framed house in Indio, Calif.

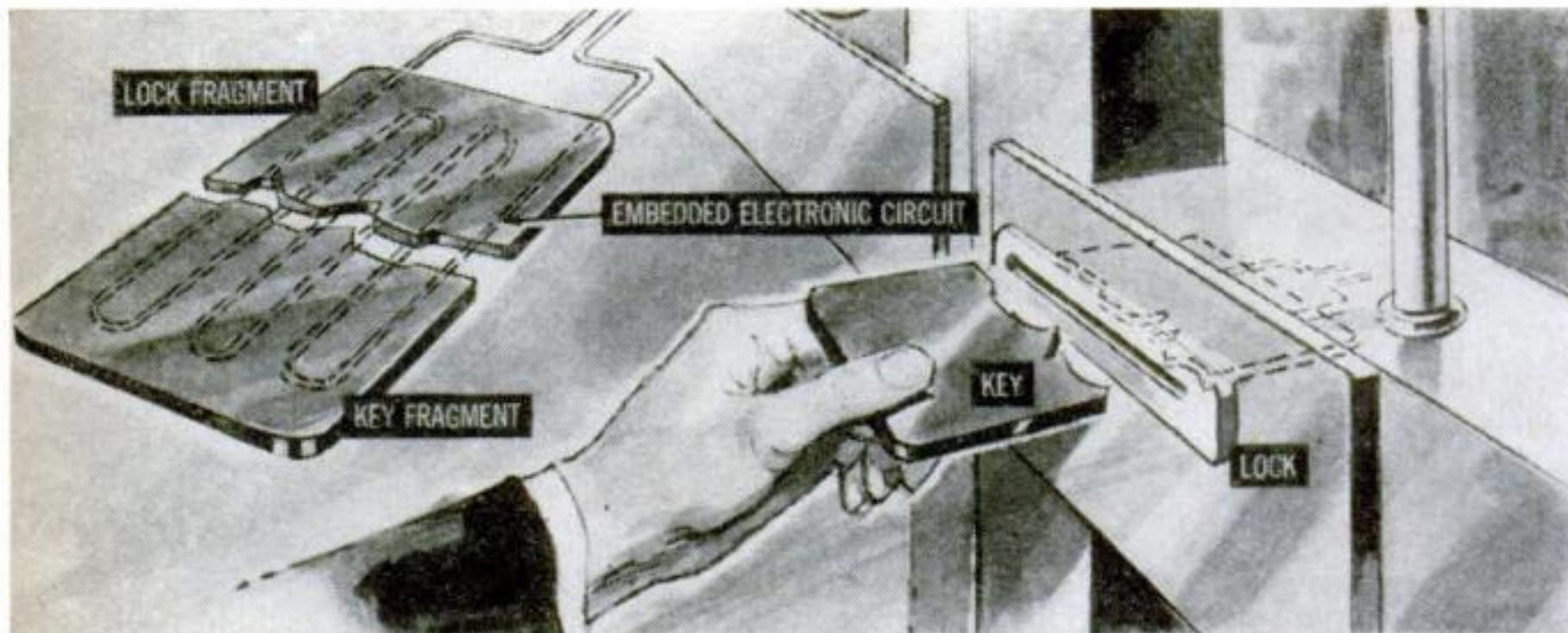
Truman Ratliff, owner-builder, says that he and one helper put up the skeleton in a day by using an "A" frame on a flat-bed truck. They lifted two-by-four-inch steel supports onto poured concrete footings and bolted them in place 12 feet apart. To these they welded eight-

## Broken key for electronic lock

Break a small sheet of opaque plastic into two parts and you get a key that can't be duplicated and a lock that can't be picked. A patent was recently granted

to its inventor, Luther G. Simjian, Greenwich, Conn., who suggests its use for vaults, doors to top-secret military rooms, code machines, bank-deposit devices, check-signing machines.

How it works is shown in the drawings.



**EMBEDDED** between a double plastic sheet is a printed circuit, or wiring. To form lock and key, the sheet is broken into two ragged-edged fragments. One piece, when incorporated in a vault slot, becomes the system's lock.

**TO OPEN THE LOCK**, the key fragment is put into the vault slot. The ragged edges and the hidden wiring of the two pieces must mate exactly to complete the lock-opening circuit. Any other connections can send an alarm.

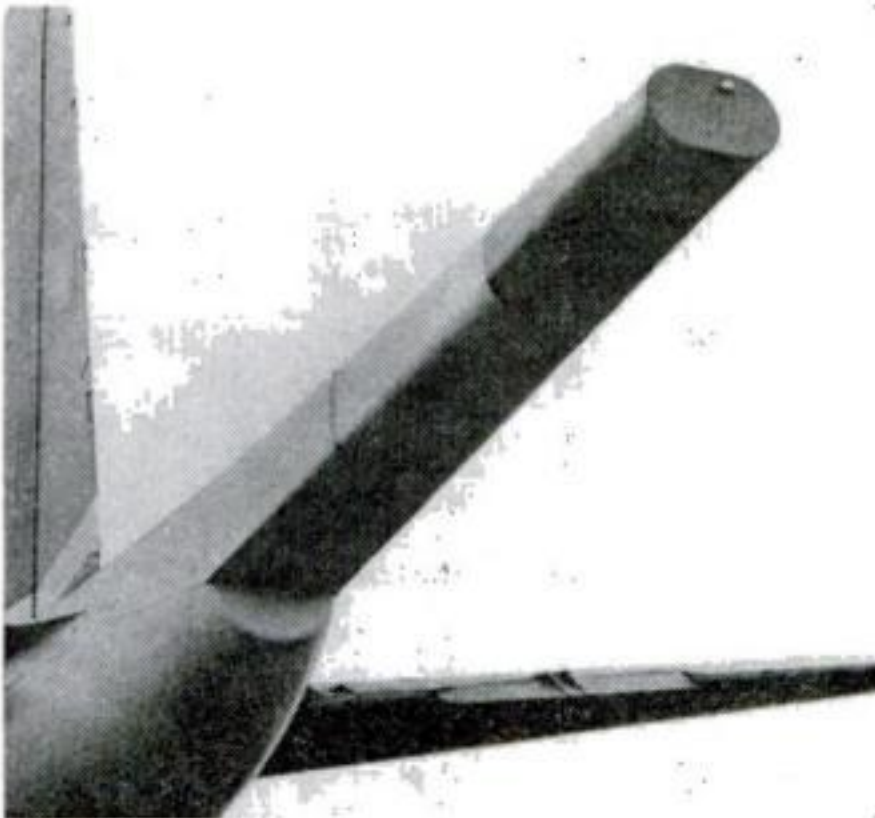




poured after roof beams and supports were placed. Holes in beams will accommodate ductwork.

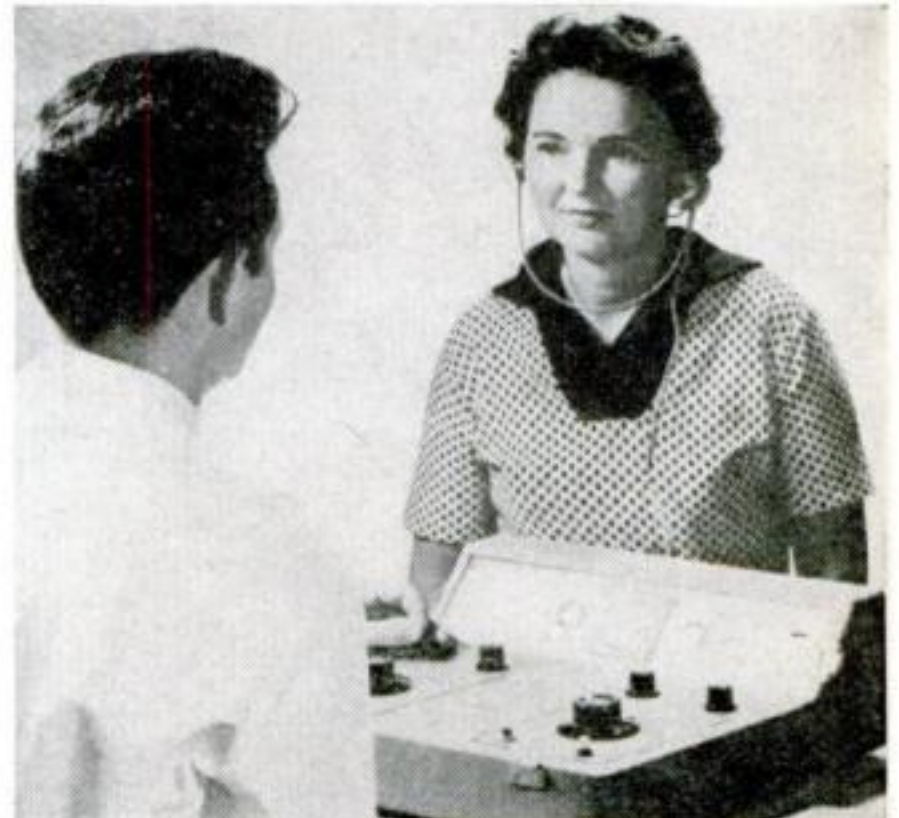
inch Bethlehem "I" beams with a borrowed 200-amp welder. The supplier had cambered the beams to order in his shop. The two-bedroom, \$17,000 house sits on a 10-acre sand dune with a superb mountain view. Designer Walter White of Palm Desert included 2,100 square feet in the rectangular floor plan. He formed five bays with the curving roof; the smallest, on one side, is a carport.

**V-SHAPED STEEL POST** supports each upward-curving roof beam. The posts are four-inch channels sheathed in 16-gauge sheet metal. Thin, vertical pipes are plumbing trees.



### Long-tail spotter

The long tail of Lockheed's sub-hunting P3V-1 houses magnetic detection devices. A fiber-glass boom extends beyond interference from metal stabilizers and tail cone. The propjet, military version of the Electra, can search 280,000 square miles on each flight. The bulb at top of the tail plug is a navigation light.



### Loss-of-hearing tester

By turning dials on this instrument, a doctor or technician can measure the degree of a patient's hearing loss and write a prescription for a custom-built hearing aid to correct it. The tester can evaluate more than 40,000 hearing configurations. It's called an Auricon by Audiotone of Phoenix, the developer.





# Nothing's Too Good for Baby Gorilla

*Only a handful at seven months—pretty small to bear the honors due her as an international celebrity—Colo could already eat with a spoon, drink from a cup.*

*Today, at 3½ years, Colo weighs 65 pounds and, like any youngster, loves to play. Right now it's tickling time.*

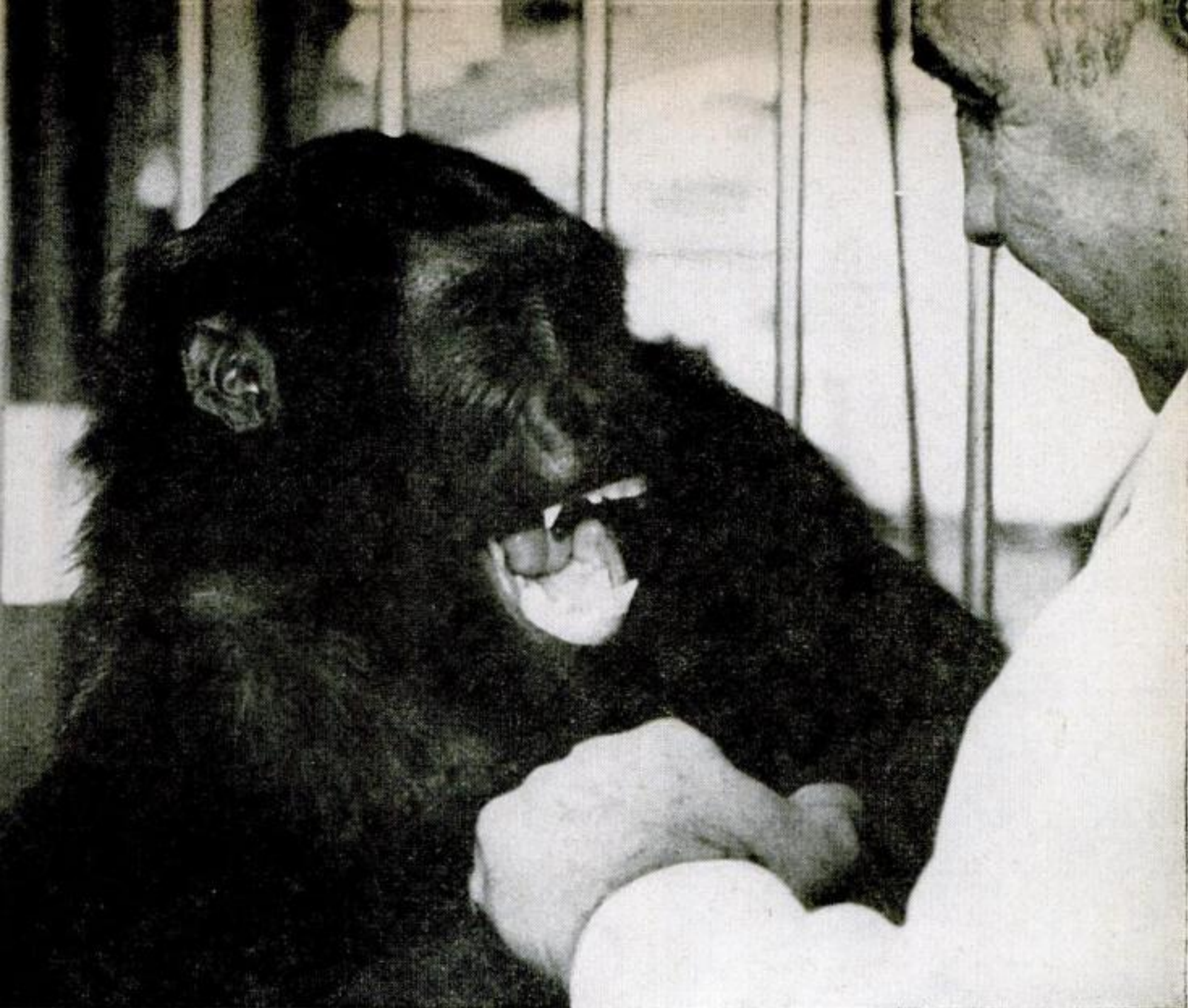


*When it comes to art, Colo knows what she likes—she likes her own finger paintings. Here she points out an interesting feature of her work.*

*Everybody needs a little love and attention. An understanding nurse, who drops by regularly to check her over, coos to Colo reassuringly.*







*"Oh, you're a bad, bad gorilla!" says Zoo Director Earl F. Davis, chucking Colo under the chin. Romping with her now is fun, but full-grown she'll weigh 350 pounds—and good zoo directors are scarce.*

***The first gorilla baby born in captivity is being terribly spoiled for the sake of science***

**By George J. Barmann**

**T**HE most pampered baby in the world, perhaps, is a saucy gorilla named Colo. She lives in the Columbus, Ohio, zoo.

Colo is the first gorilla ever born in captivity anywhere. She is giving scientists a unique opportunity to study a gorilla from birth, knowing its exact age in all stages of development.

So little is known about gorillas that 65-pound, 40-inch-tall Colo is being watched over by white-uniformed nurses 24 hours a day, and is being studied by child specialists and psychologists.

Until Colo was born, on Dec. 22, 1956,



*Hitting the bottle at lunchtime, Colo displays a no-problem appetite. She readily tucks away steak, vegetables, fruit, vitamin pills—and adores tea.*

CONTINUED





*The little gorilla is growing up in quarters as spotless as any hospital nursery. She's shown here as an infant, being coddled after the daily rubdown with baby oil.*



*Just waiting for that good warm cereal. It's being spooned out by Mildred Davis, wife of the zoo's director and one of Colo's admirers.*

all attempts to breed gorillas in captivity had failed. Scientists had about decided the beasts could not reproduce outside the jungle. But Director Earl F. Davis of the Columbus Zoo was not convinced. He put his two full-grown gorillas, the Baron and Christina, together for a time and waited anxiously.

Colo, a priceless blessed event, was the happy result. She is getting as much care and attention as if she were a human baby in an exclusive hospital. She is fed balanced meals. She is checked regularly each day and a record is kept of her progress. She gets manicures. She is given companionship and encouraged to play. Romping with her, says Director Davis, is "like handling flypaper; she won't let you go."

Offers for brown-eyed, bouncy Colo come to Davis from all over the globe. European zoos have tried to buy her. The Brookfield Zoo, in Chicago, wanted Colo there for a month, at \$1,000 a day. But Davis is rejecting them all. "We could make a mint hauling her around," he says, "but she belongs right here."

Colo's health is so precious that every time she looks sad the zoo people get jittery. For gorillas are susceptible to all of man's diseases. Already she's had the flu and colds, and Davis thinks she's had measles. Temperature in the nursery is kept at 75 degrees. Visitors have to look at Colo through a display window, as they would view a new baby in a hospital nursery.

There are 60 gorillas in U. S. zoos, 20 in Europe. But little Colo, with her distinctive birth, tops them all. Even another baby gorilla, Goma, born in Basel, Switzerland, last September, cannot match her. Colo was first.



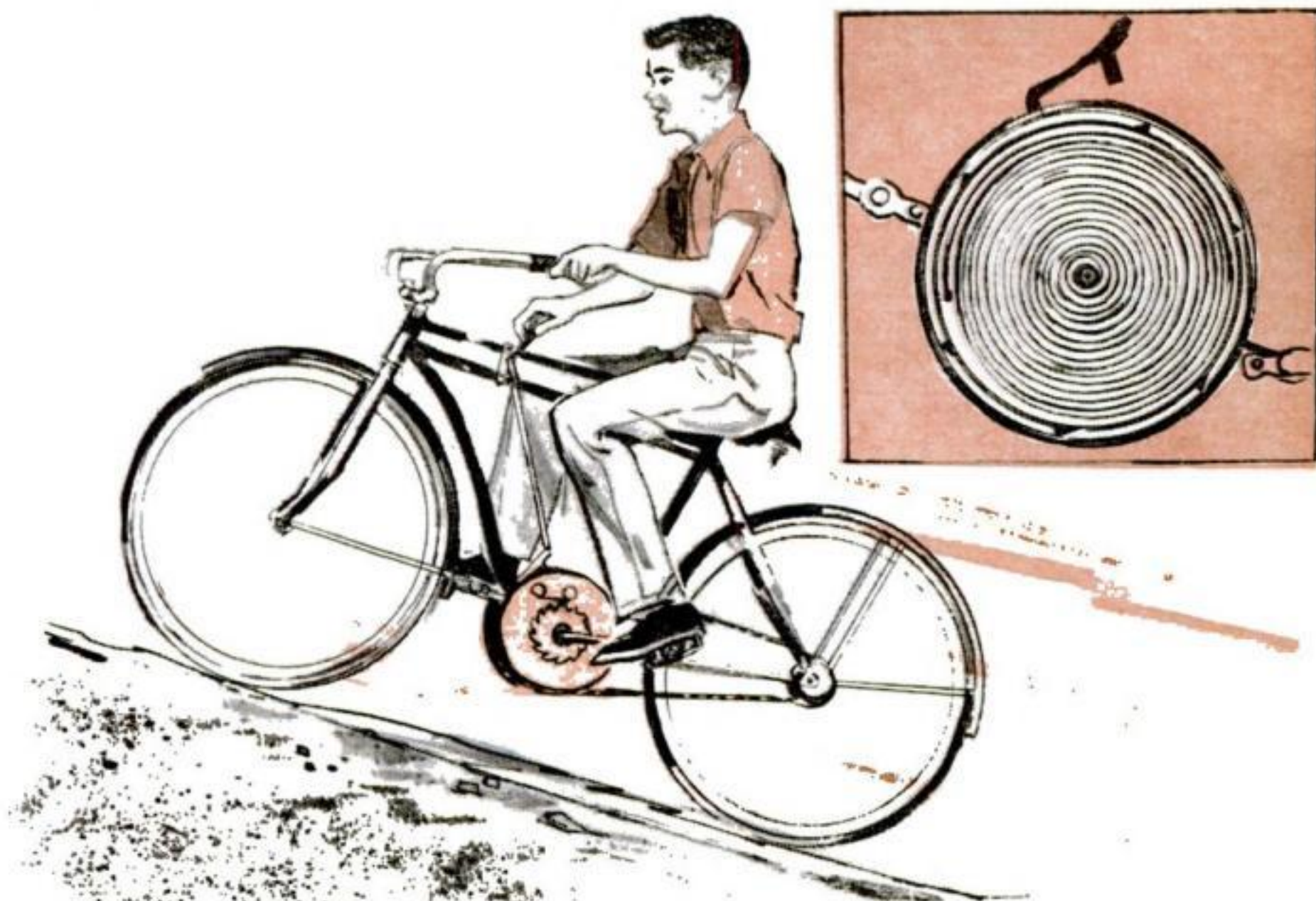
*Family album: father at left, mother at right. Baron, the father, tips the beam at 570 pounds, has a four-foot-wide chest. He's about 15 years old. Colo's mother, Christina, stylishly svelte at 350, is a youthful 11. No one knows how the handsome couple feel about their unique offspring.*





# New Ideas from the Inventors

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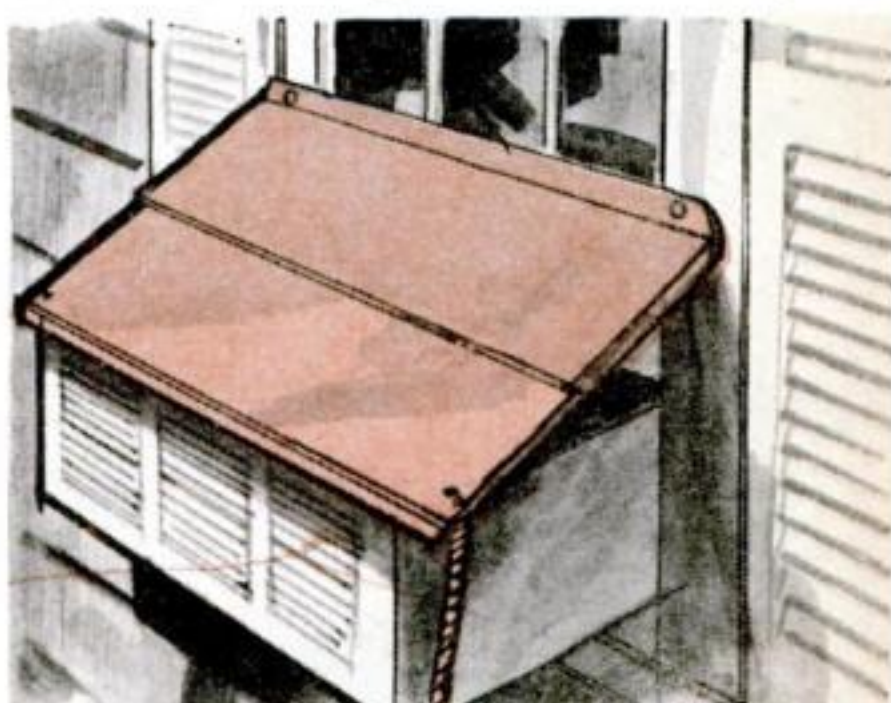
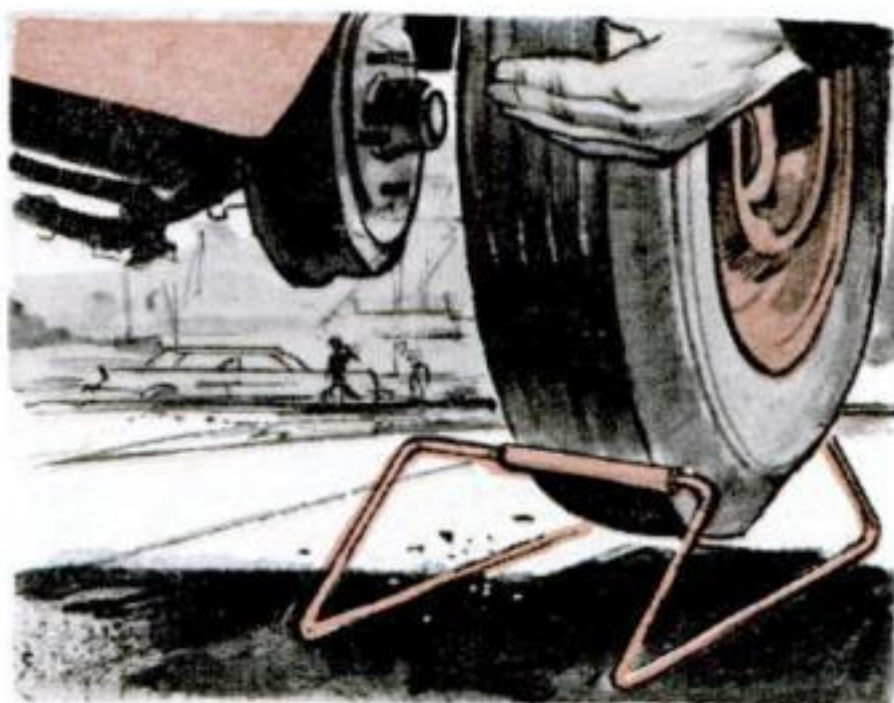


**Bike Spring Stores Power.** Cranking the pedals of this recently patented bike drive would transmit power to the wheel sprocket through a coiled spring and

drum. A disconnect lever on the crossbar would let the rider store pedal power when the going was easy, release it to start fast, climb a hill, or buck a wind.

**Rack Eases Wheel Change.** This sleeved wire rack is one inventor's idea of how to change a tire with less effort. The springy cradle would raise the spare to the right height. You'd then turn it on the sleeves to line up lugs and holes, and slide the wheel forward onto its hub.

**Awning Shields Conditioner.** An air conditioner's operation can be improved by shielding it from the sun's rays. Fastened by a flange at the top and a looped spring at the bottom, this extensible panel wouldn't impede air circulation yet would deflect sun, and rain and dirt, too.





## More Inventors' Ideas



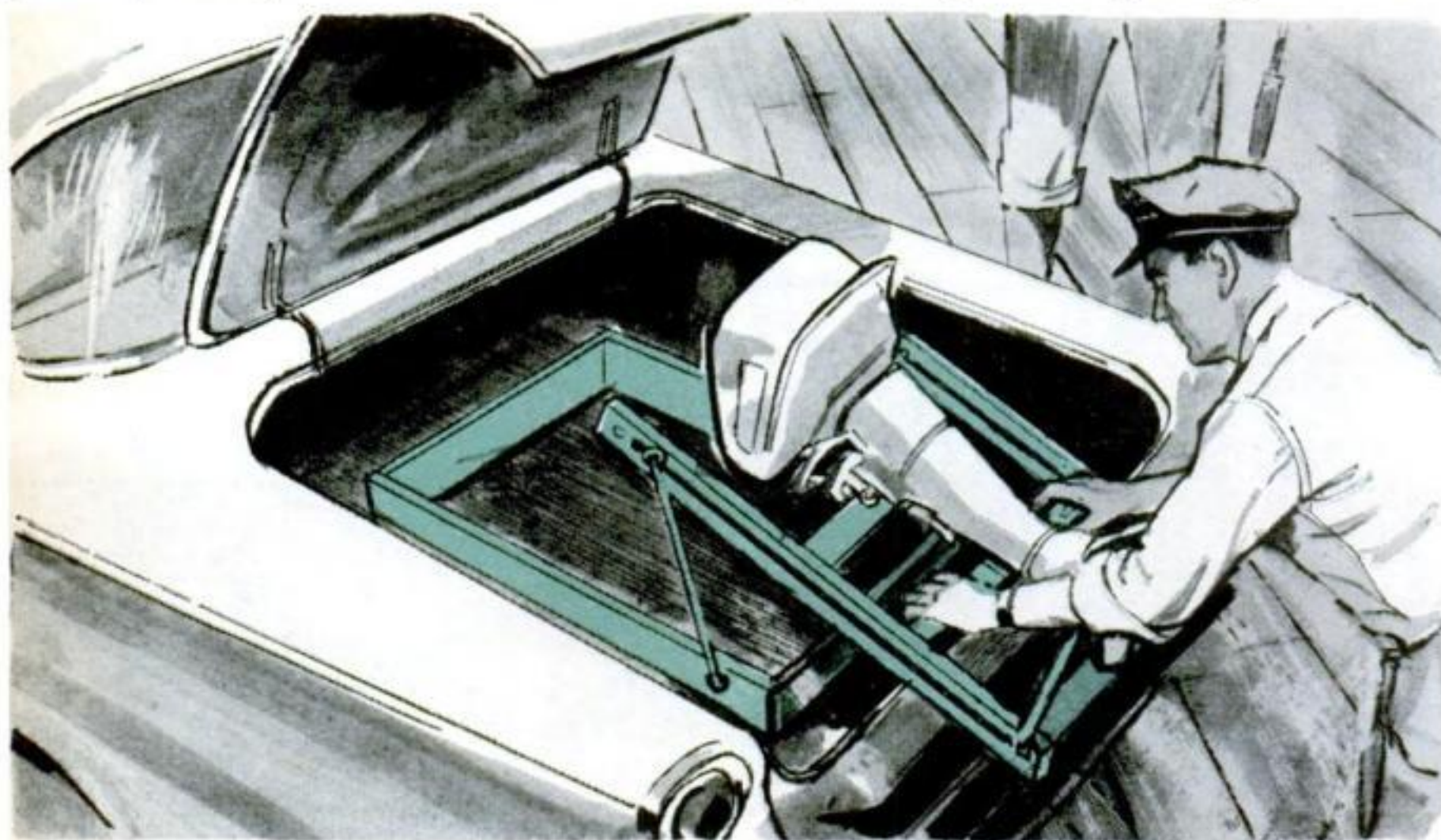
**Instant Cup Heats Instant Coffee.** You could make hot drinks quickly and easily at a picnic or barbecue by heating water in the cup. The base of this metal mug would hold a wick-type heater. The rim and clip-on handle, made of nonconductive material, would remain cool.



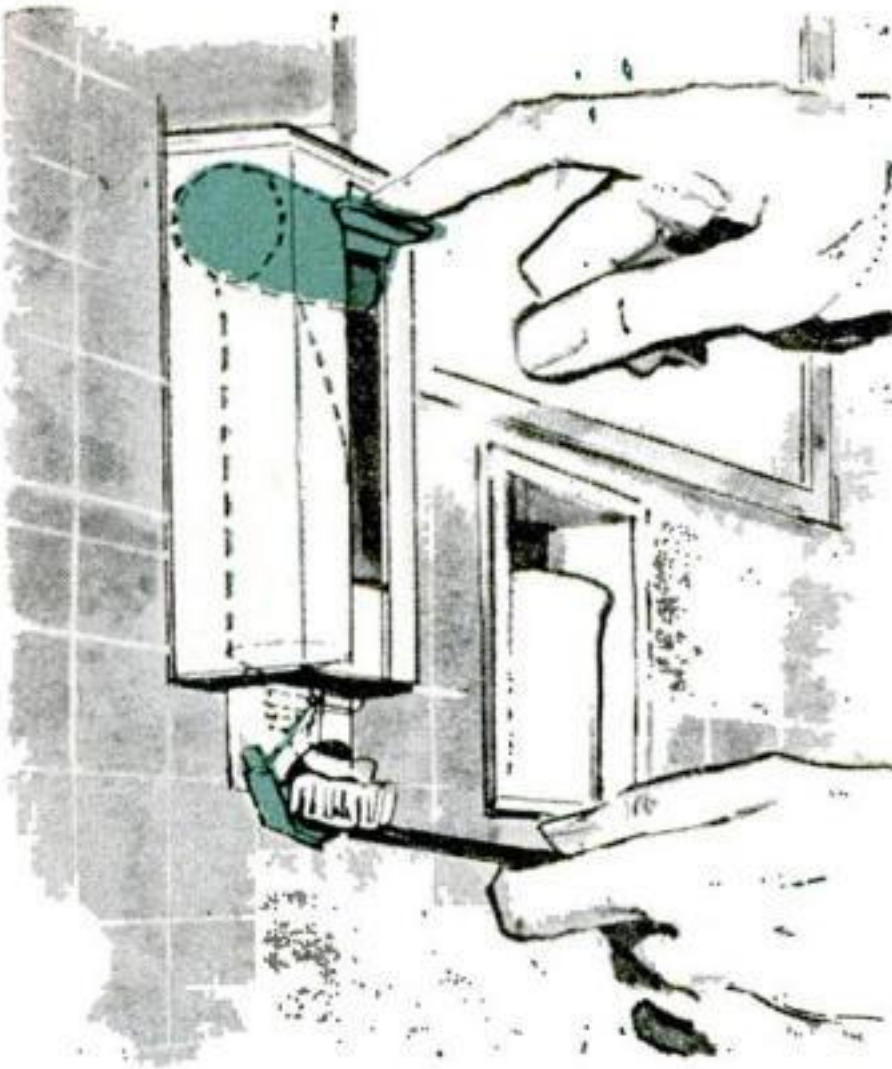
**Caster Flats Prevent Sliding.** Vibrating machines might stay put if mounted on casters like these. Small flats would resist a machine's tendency to creep or roll, but wouldn't resist too hard when you pushed the appliance. Springs on the spindles would cushion the ride.

**Trunk Carrier Loads Outboard.** You could hoist an outboard motor into a car trunk with ease if it were clamped to the pivoted, sliding frame of this carrier.

Nested inside a second, screwed-down frame, the motor couldn't shift inside the trunk. To unload, you'd pull the mounting frame up and out, tilting it down.







**Holder Squeezes Toothpaste Tube.** To squeeze toothpaste from this wall dispenser, you'd press a lever that rolled a cylinder against the tube. Placing your brush in a cradle at the base of the dispenser would uncap the tube; a spring would recap it with the brush removed.

**Ratchet Sounds Back-Up Signal.** Pulling out of a busy parking lot might be easier—and safer—if you attached this bolt-on signal to your car's wheels. A spring fastened to a bell clapper would turn freely when you were going forward. But in reverse, a ratchet would engage and tighten the spring, jiggling the clapper against hubcap or wheel cover.



**Fender Catches Paint Drips.** This semi-circular guard is designed to catch the paint that spins, drips, or splashes off a well-loaded roller. A pin-and-hold arrangement would let you rotate the guard to the best position for each job.

The following patents have been issued on these inventions: **Bike spring**—No. 2,908,356 to E. Daarud, Mandan, N. D.; **Tire rack**—No. 2,910,201 to R. Finn, Chester, N. Y.; **Awning**—No. 2,874,551 to C. H. and W. S. Bradbury, Topeka, Kan.; **Cup**—No. 2,893,376 to A. Pasqua, NYC; **Caster**—No. 2,866,222 to W. Lord, Minneapolis; **Outboard carrier**—No. 2,778,517 to S. Weinstein, Oak Park, and J. Walker, Allen Park, Mich.; **Paste dispenser**—No. 2,801,028 to M. Ward and W. Wood, Harper Woods, Mich., and C. Baker, Detroit; **Back-up signal**—No. 2,802,441 to H. Epstein, Kansas City, and J. Pratt, Independence, Mo.; **Roller guard**—No. 2,902,706 to C. Gaeke, St. Paul, Minn.

Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D. C., at 25 cents each. To write to an inventor, if the address given above is insufficient, you may address him (by name and patent number) in care of the Commissioner of Patents.





**PARKED CARS TAKE A BEATING** when monster hailstorms strike. Huge stones shattered every

window on this Packard and left hundreds of grapefruit-size dents in the sheet metal.

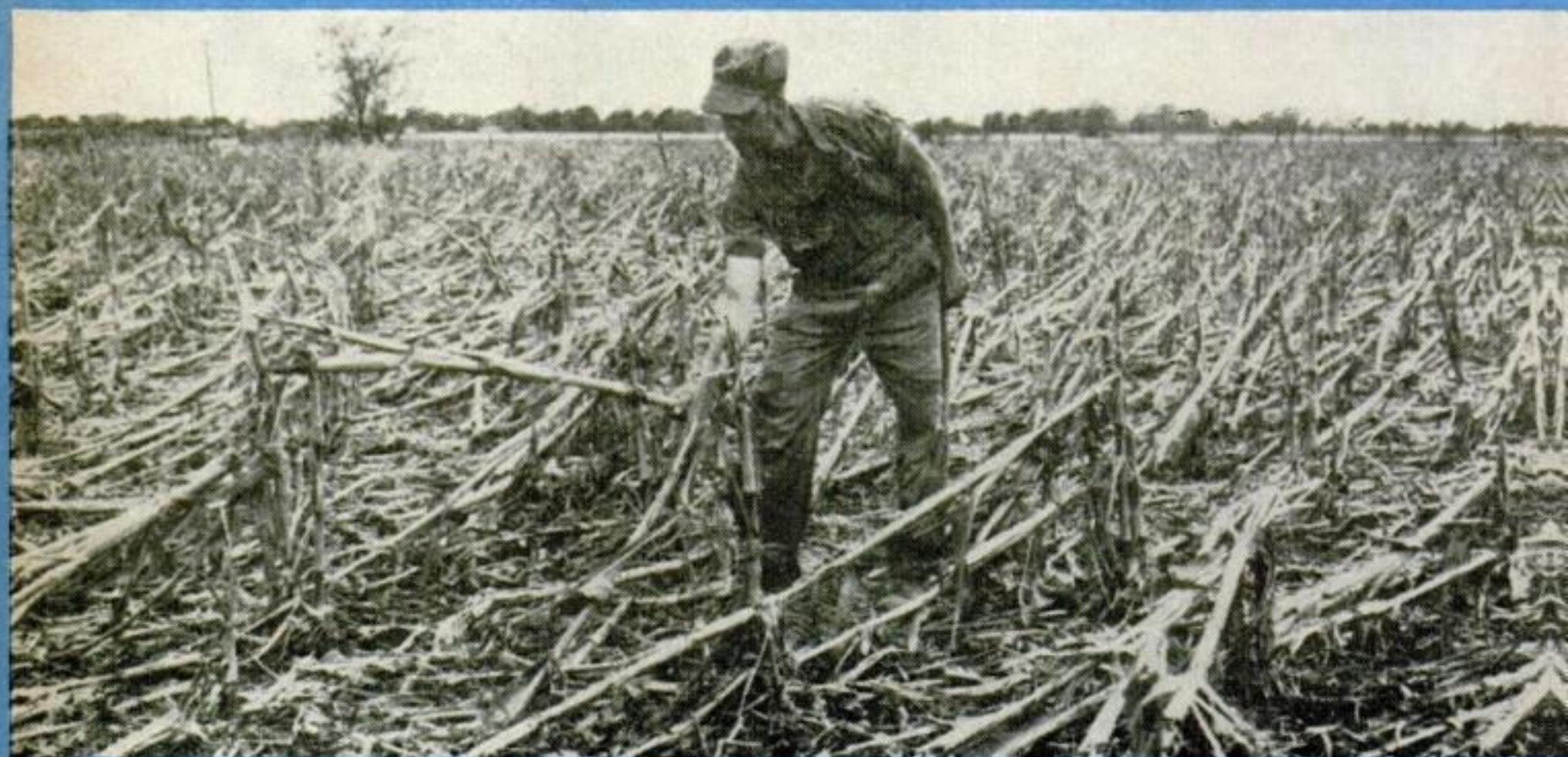
**More destructive than tornadoes...**

# HAILSTORMS

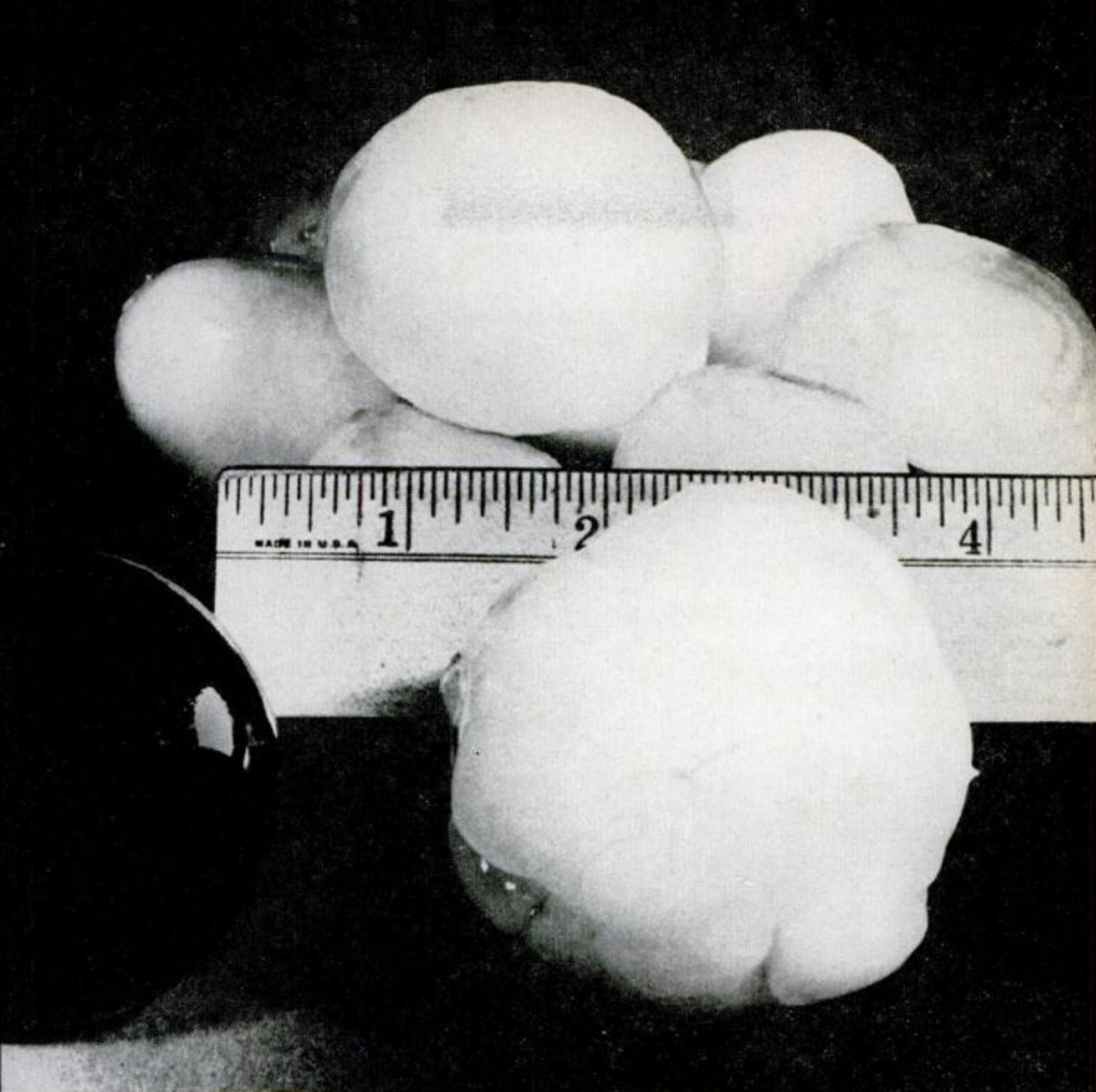
***Despite man's recourse to science and sorcery, Nature's freak icy bombardments still cause damage in the millions***

**HEAVIEST SUFFERERS** from hail are farmers. Corn stood seven feet tall in this Monmouth, Ill.,

field when it was struck down by storm that destroyed some 20,000 acres of crops.







Oklahoma hailstones, almost three inches across, are as big as the doorknob at left.

### By Wesley S. Griswold

**C**AUGHT in a vast Nebraska field by a wild thunderstorm, one June day long ago, a running farmer was knocked unconscious by huge hailstones. When he came to, the stunning barrage had stopped. But it had broken one of his arms and bruised him savagely.

The terror of having been at the mercy of raging elements was still upon him when he staggered home to his wife.

"I felt as if God had suddenly started throwing rocks at me," he told her.

That same discharge of celestial shrapnel broke the backs of numerous hogs, fractured the skulls of grazing horses

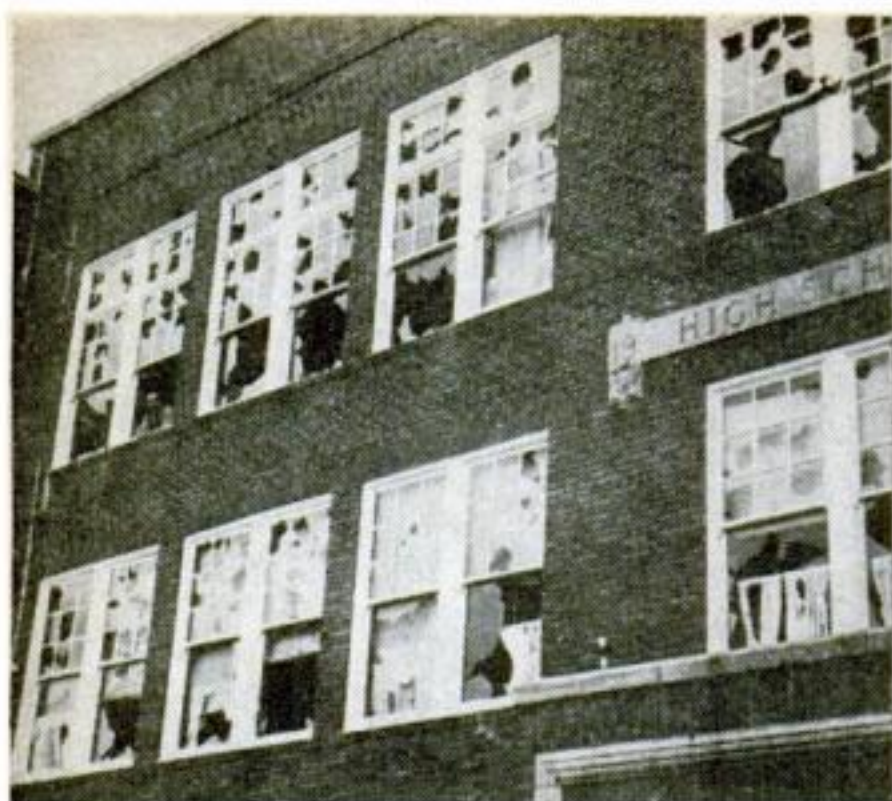
and cows, and slew flocks of chickens. It stripped orchards of their fruit and leaves, flattened hundreds of acres of young grain. Flung by a wind nearly as violent as a tornado, great jagged chunks of ice shattered windows, punctured roofs, and injured several men trying to rescue their crazed livestock.

Within 15 minutes, this historic hailstorm of June 20, 1881, like most others of record, was all over.

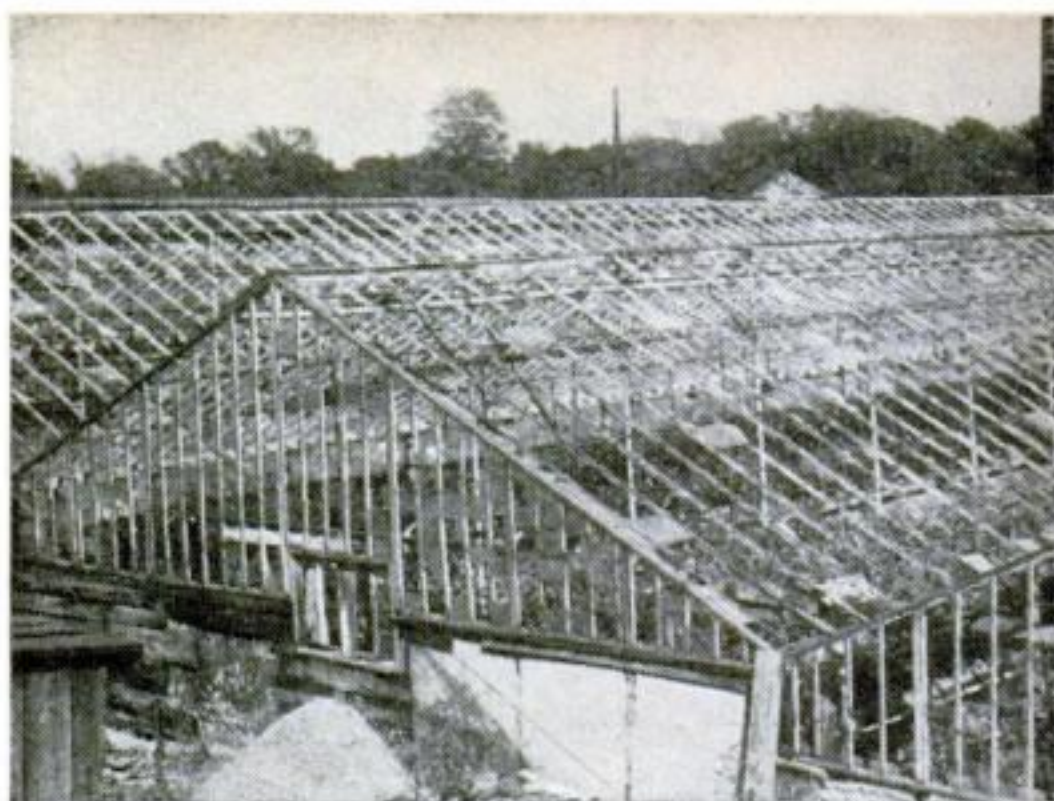
The physical beating we Americans took from hail during a recent 10-year period cost us over \$532,000,000. Hailstorms are more destructive than tornadoes and nearly as harmful as hurricanes.

*Working its way north.* Farmers take





**SOME 90,000 WINDOWS** were broken when a 50-m.p.h. hail barrage pummeled Spearfish, S. D. Damage to the high school is shown above.



**GREENHOUSES ARE LEFT WIDE OPEN** after Nature's freak stone-throwing. This one did damage of about \$100,000 near Washington, D. C.

the worst pummeling. With what must seem to them to be sheer meanness on Nature's part, hailstorms normally begin when shoots start coming out of the ground, and keep occurring straight through the entire growing season. Hail usually hits farms farthest south beginning in March, and winds up beating a tattoo on northernmost fields in late August. June, however, is the month when hailstorms are most frequent.

Hail has fallen in every state of the Union, including the two newest. But those that have been pounded hardest and most often are Kansas, Nebraska, Montana, Iowa, and North Dakota, in that order.

Wheat, corn, and tobacco crops have been the hail's chief targets, with fruit next in line. A single storm in Nebraska on July 2, 1953, mashed 3,000,000 bushels of standing wheat.

In American towns and cities, hailstones have busted countless thousands of windows, riddled greenhouses, smashed auto windshields, street lights, and electric signs. They have badly damaged just about every kind of roofing except concrete slabs, and have whanged right through the flimsier types. Hail has split and even torn wooden siding off houses. In Warsaw, Mo., in June, 1931, it knocked a front door off its hinges.

Trains that have had to run through fierce hailstorms have had all windows broken on the exposed side, with passengers cut by flying glass.

Planes have been in the most serious

danger, though none is known to have crashed as a result of hitting hail head-on. But in a few seconds the damage can be breath-taking.

An Air Force turboprop transport that blundered into hail for only half a minute one day last year was so hammered that it took 14,000 man-hours to make repairs. This particular hail shower hadn't even shown up on the plane's radar, which enables most aircraft to avoid such harrowing encounters.

**How big do they get?** Big hailstones are traditionally "as big as hen's eggs," but they have often been far larger than that. The largest ever reported by an official observer whopped into Potter, Neb., on July 6, 1928. It was 17 inches around and weighed 1½ lb.

Many hailstones in that brief, terrifying storm were 10 to 12 inches around. They hurtled down upon the town with the hissing sound of great speed, hitting the wet ground a dozen feet apart, and with such force that some buried themselves in the soil.

One person who watched this appalling assault said the hailstones looked like a plunging flock of small birds.

By great good fortune, no human being was hit by those icy projectiles. It is a curious fact that while many horses, cows, dogs, poultry, pigs, and wild birds and animals have been slaughtered by hail, only one person in the U. S. has ever been killed by it, according to official records. He was a young Texas farmer, who on May 13, 1930, near Lubbock, was





**MANY AIRPLANES** have been battered, though none has been known to crash due to hail. Above is the beat-up nose of a DC-6 airliner.

caught out in a violent storm and beaten so cruelly that he died a few hours later.

The history of hail in certain other countries has been far more tragic. The most lethal hailstorm ever known killed 250 people in north central India on an April day in 1888. One almost as deadly took 200 lives in western China in June, 1932. The worst hailstorm that ever hit South Africa made such an uproar on roofs with its "jagged lumps of ice" that as it beat upon a large power station, it drowned out the sound of the dynamos. That storm killed 19 people.

Hail falls on all continents, most often between two p.m. and nine p.m. It is most frequent far inland in the middle latitudes, least likely to be encountered near the equator and the poles.

**Born at 250 m.p.h.** Its incubator is almost invariably a violent thunderstorm, for it feeds on turbulence. In fact, the largest hailstones are formed in the front clouds of such a storm, where the updrafts are often vertical hurricanes roaring at speeds exceeding 250 m.p.h.

Wind-tunnel experiments have indicated that updrafts of 248-278 m.p.h. would have been needed to help build the giant that landed in Potter, Neb.

A thunderstorm is usually created when a layer of warm, moist air is overrun by a layer of cool, dry air. The hotter the atmosphere close to the ground, the greater the chance that an uprush will start, and the more vigorous it will be. Turbulence is even likelier to occur when the heated air is moving up a slope



**PIERCING POWER** of giant hailstones is shown in this detail photo of an automobile top that was riddled as if by aerial machine-gun fire.

of land, as happens, for instance, when air from the Gulf of Mexico pushes northward across the High Plains. That is why the worst thunderstorms in the U. S. happen in that great central farming region. And, though only one thunderstorm in 10 produces hail that reaches the ground, that is where the most damaging falls of hail occur.

There are two theories about how it is produced. Both agree that a hailstone starts with a little round nucleus of compact snow or with a freezing raindrop. From there on, they differ.

The older and more widely accepted explanation is that this nucleus is the plaything of tumultuous updrafts. First, it is tossed up into regions of snow, then dropped into supercooled rain, then flung upward again until, after repeated tosses and alternate coatings of snow and ice, it becomes too heavy for the tumbling winds to support, and falls to earth.

The other theory is that the hailstone makes a continuous fall from start to finish, though sometimes it meets such powerful uprushing winds that it stands still for an instant in mid-air.

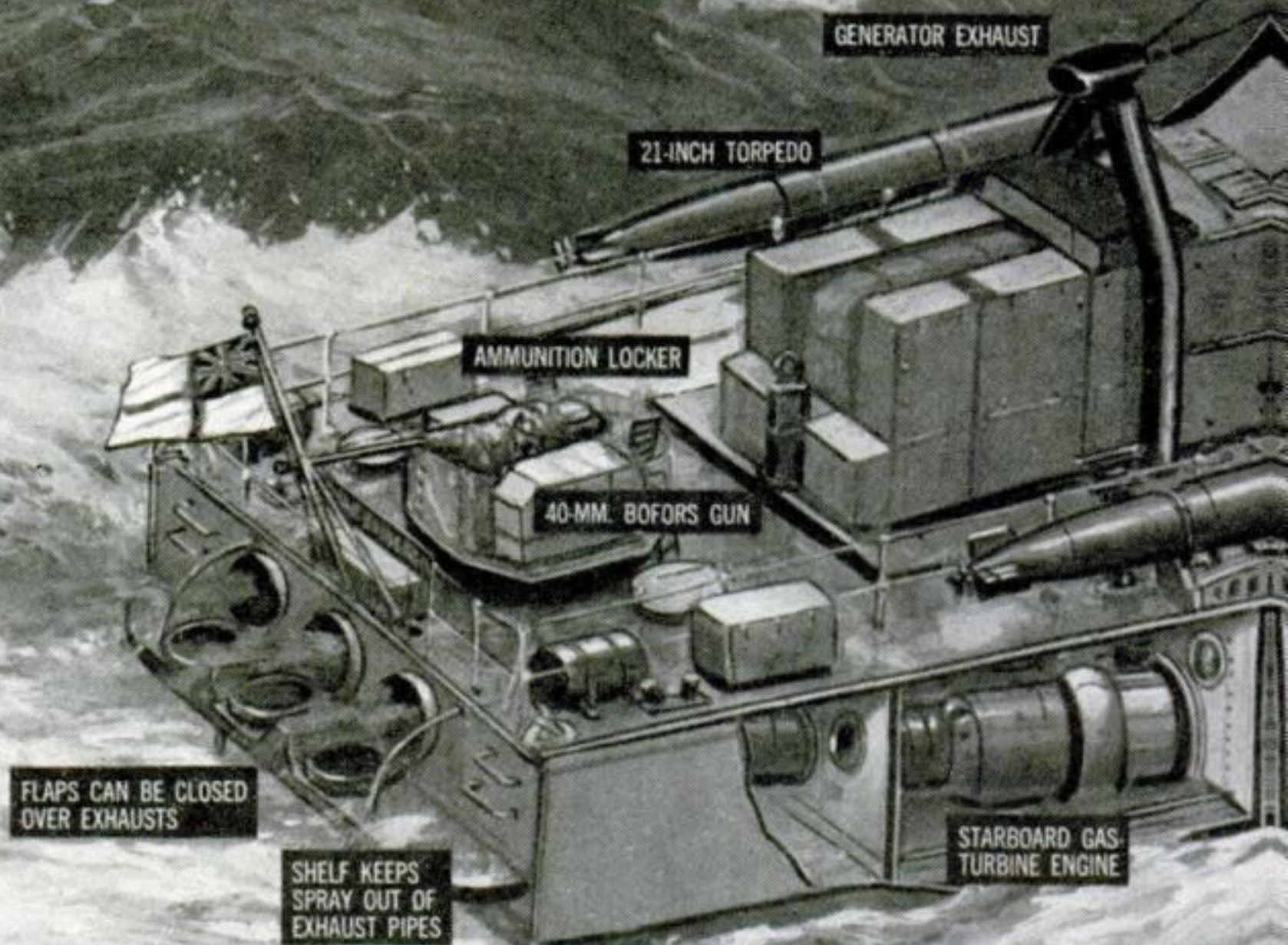
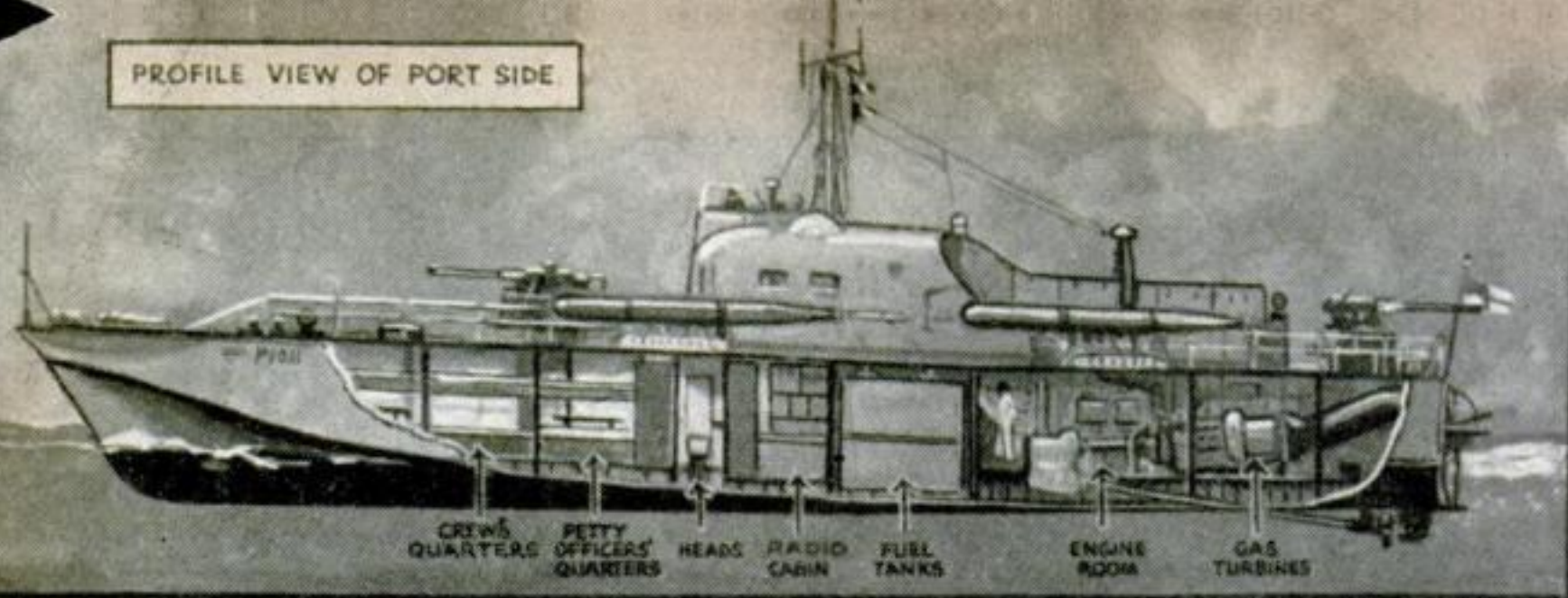
**With spikes, too.** However it is formed, hail reaches the ground in an amazing variety of sizes and shapes. It can be as small as a pea or as big as an orange. Usually, it is roughly round and smooth. But hailstones have been found covered with icy spikes, or shaped like pyramids, mineral crystals, or crude arrowheads.

Though hailstorms rarely last more

[Continued on page 218]



PROFILE VIEW OF PORT SIDE



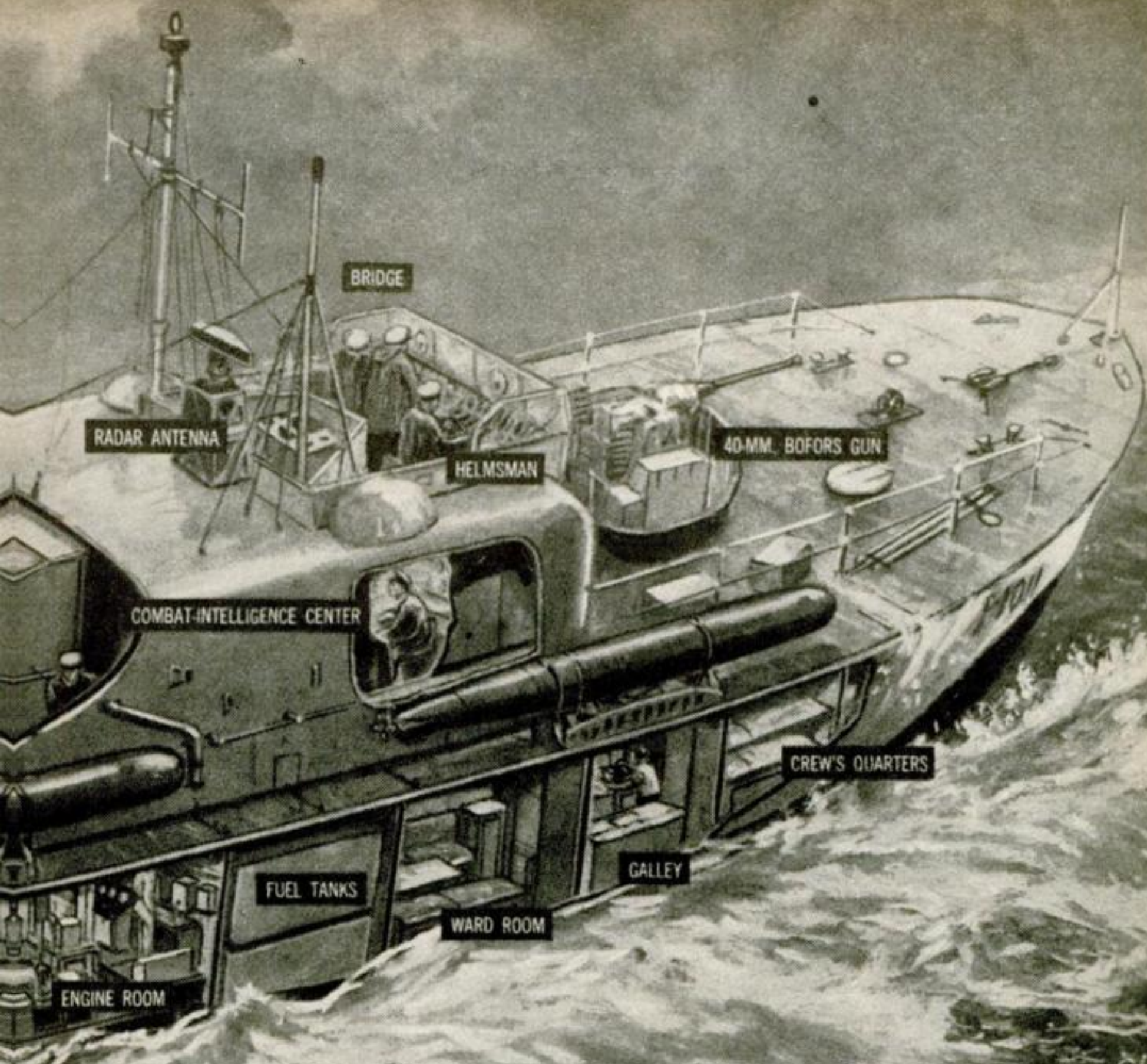
## World's Fastest Fighting Vessel

WITH three 2,800-hp. gas-turbine engines spinning its triple screws, HMS Brave Borderer accelerates from rest to 50 knots in only 30 seconds. First of a new class built for the British Admiralty by Vosper Ltd., the patrol craft can operate as a gunboat, torpedo boat, mine layer, or raider. It is believed to be the first warship with a service speed of over

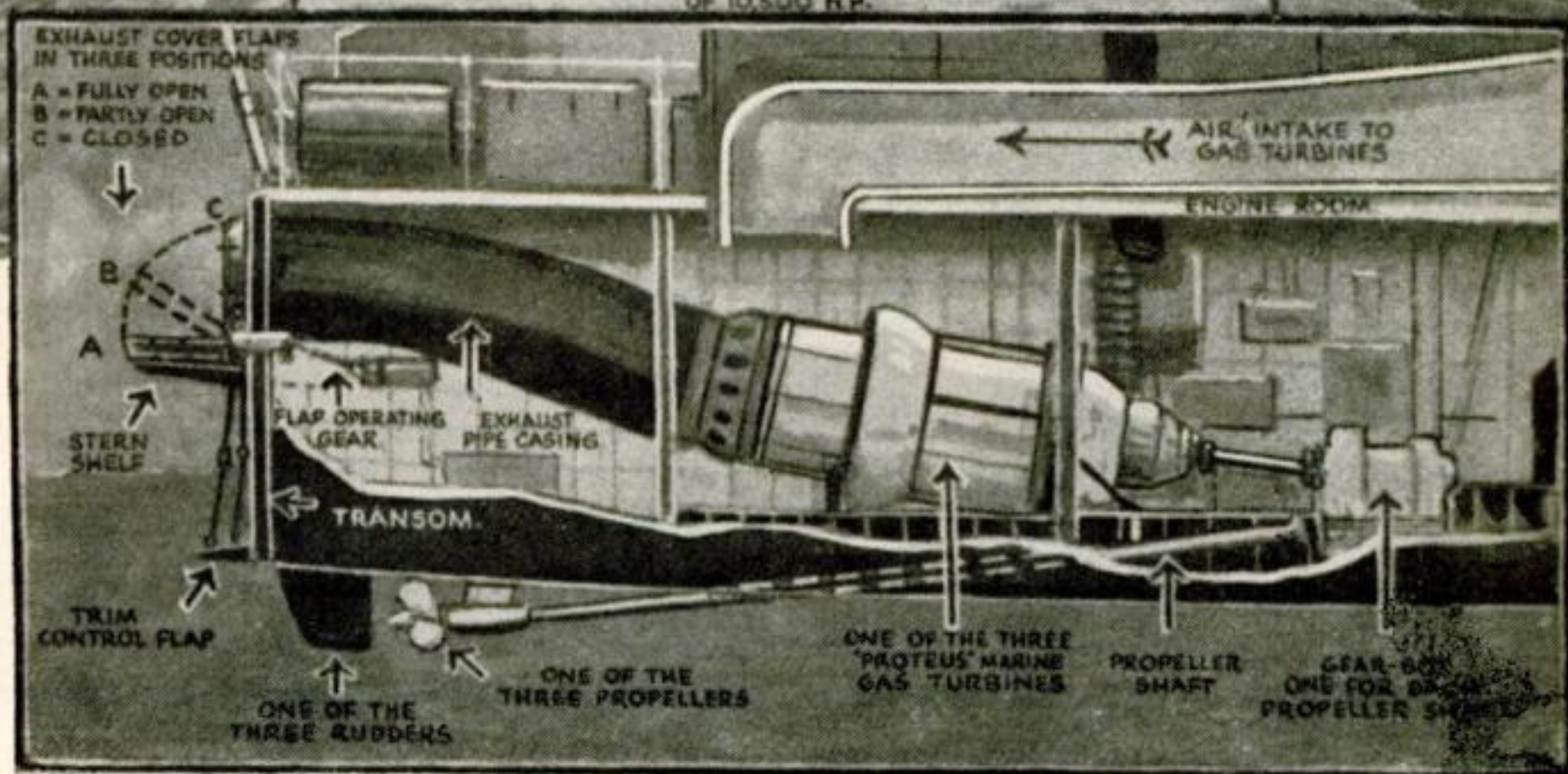
50 knots, about 57 land miles an hour.

Displacing 100 tons when loaded, the vessel is 98.5 feet long, overall, and has a 25.5-foot beam. Hinged to the bottom of the transom is a unique trim flap controlled electro-hydraulically from the bridge. Lowering the flap points the boat's bow higher for greater speed or to reduce slamming in a heavy sea.





A DIAGRAM OF THE VEE-DRIVE WITH REVERSE GEAR-BOX AND THE "PROTEUS" MARINE GAS TURBINE INSTALLATION, WHICH DEVELOPS A TOTAL OF 10,500 H.P.







Sand-table models are observed by Army personnel through holes shaped like binoculars.



Then they are reconstructed from reports over phone.

## Table talk teaches languages

Here's a new way the Army teaches its officers and men to speak and understand foreign languages at the Presidio school in Monterey, Calif. It uses two sand tables and modeling clay.

One group is required to observe an enclosed terrain through peepholes shaped like binoculars and to report in a NATO tongue over the telephone. A second rebuilds it from the description.

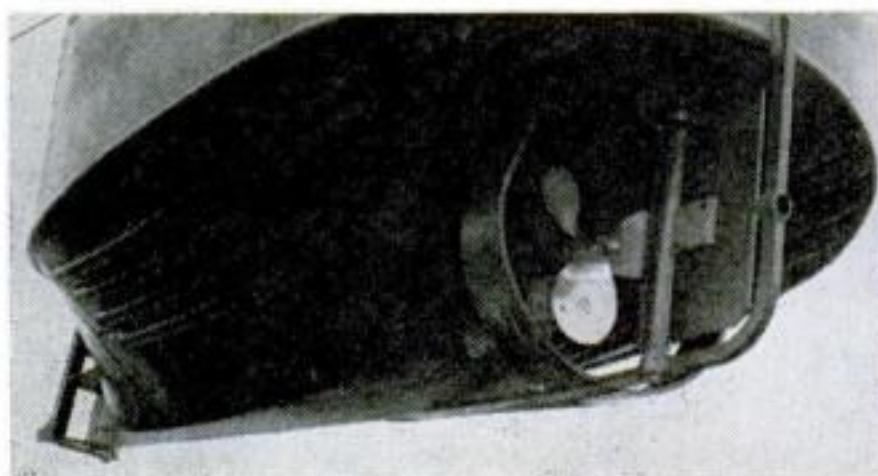


**LITTLE BOAT** makes turn in almost its own length, gets up to full speed in two lengths.

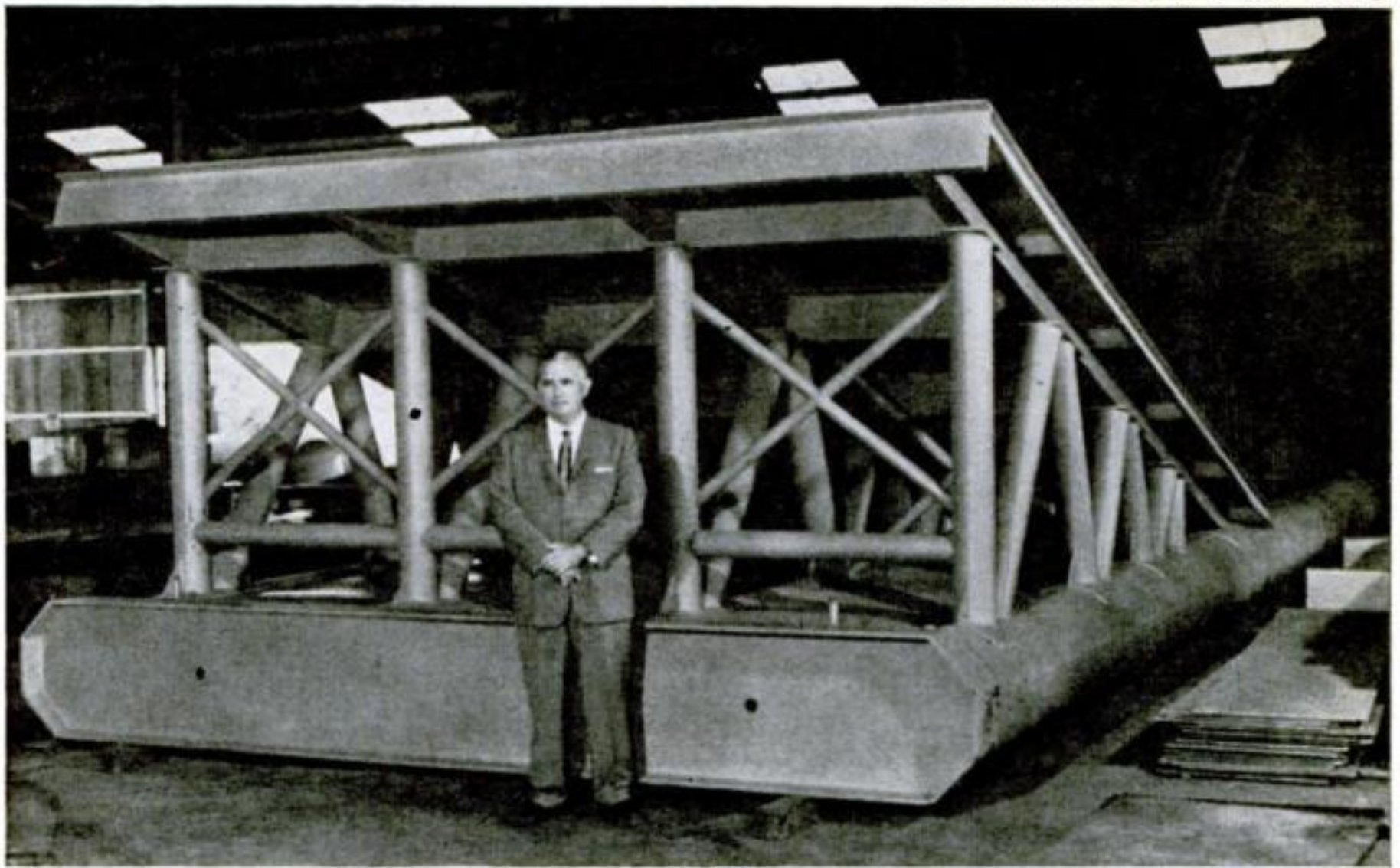
Shrouded propeller prevents damage from logs.

## Water bulldozer

A 16-foot tublike boat is being put to use by Alaska Lumber and Pulp Co. for herding logs on waterways. The 140-hp. diesel-powered craft is sturdily built—with  $\frac{1}{2}$ -inch steel-plate hull—and can turn around in almost its own length.







**TEST MODEL** above is 9 feet high, 15 feet wide, 38 feet long, and would subdue 7-foot waves in 15 feet of water. A sea raft in actual use would be larger than a football field.

### Movable breakwater

A big raft topped by an inclined plane is being tested by the Army Engineers' beach-erosion board for possible use as a breakwater to aid in loading and unloading ships in unprotected seas. It would be sunk, hold back waves rushing up its slanted deck, provide calm water on the other side. Weight of the waves would keep it on the bottom, but it could be made buoyant again for towing to another site by blowing out its pipe framework.



**SURF ROLLS** up the inclined plane in test off Maryland shore, but water in area behind the new sea raft remains calm. Weight of the water on its top prevents it from shifting.

### Coming and going

Two trains on parallel tracks? Not at all. It's the front and rear of a 110-car coal train taking a tunnel on a hairpin curve.

O. W. Andrews of Mullens, W. Va., spotted the locomotive passing its own caboose and snapped the picture. The curve is on the Winding Gulf Branch of the Norfolk & Western Railway in Raleigh County, W. Va.

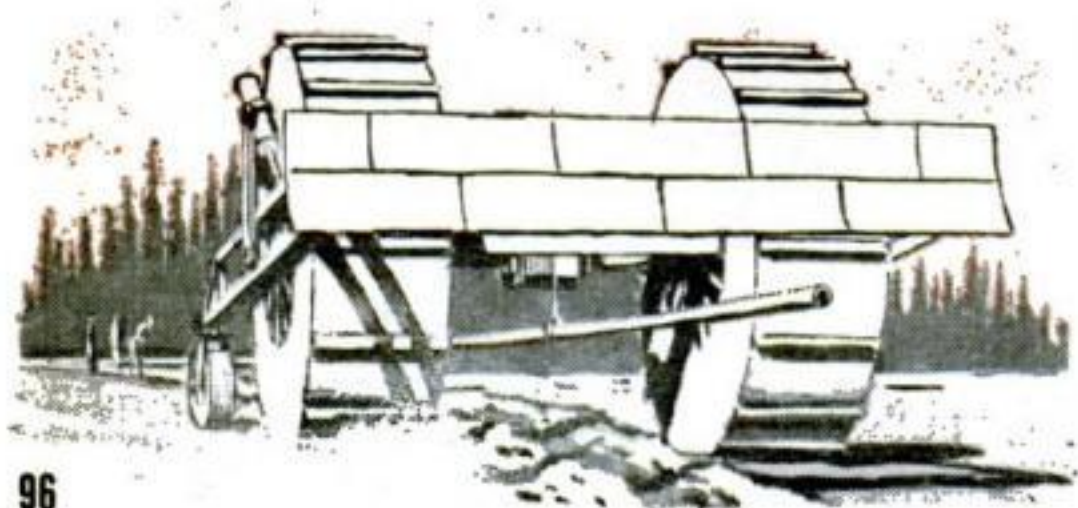






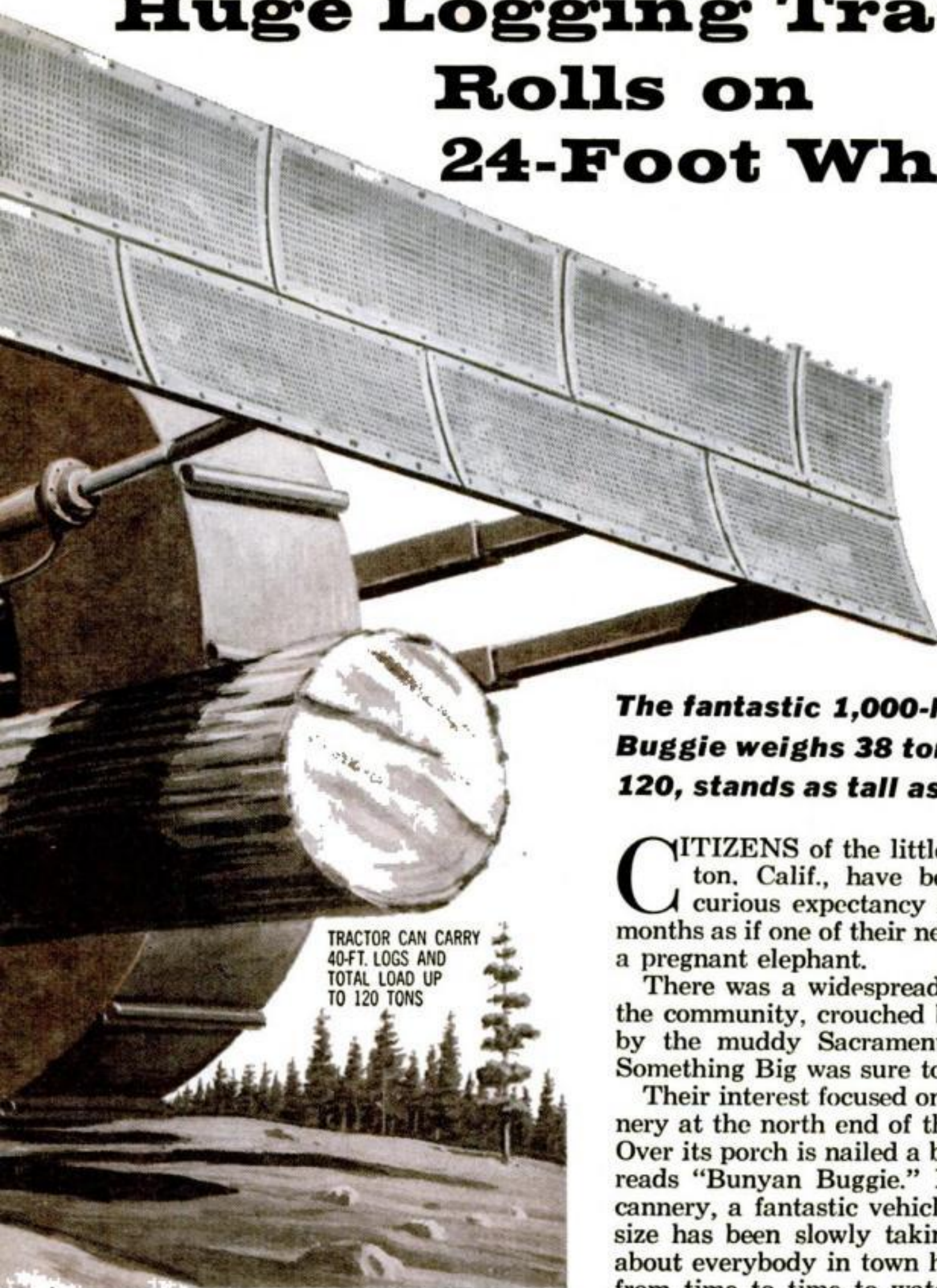
**AS TIMBER CARRIER,** Bunyan Buggy can handle 120-ton load. Logs up to 40 feet long are suspended between wheels on chain from hoist.

**AS A BULLDOZER,** tractor wields 6-ton blade, 30 feet long and 6 feet high, which can push 96 cubic yards of earth at one shove.





# Huge Logging Tractor Rolls on 24-Foot Wheels



TRACTOR CAN CARRY  
40-FT. LOGS AND  
TOTAL LOAD UP  
TO 120 TONS

***The fantastic 1,000-hp. Bunyan Buggy weighs 38 tons, hauls 120, stands as tall as a house***

CITIZENS of the little town of Isleton, Calif., have been as full of curious expectancy these past few months as if one of their neighbors owned a pregnant elephant.

There was a widespread conviction in the community, crouched behind a levee by the muddy Sacramento River, that Something Big was sure to happen soon.

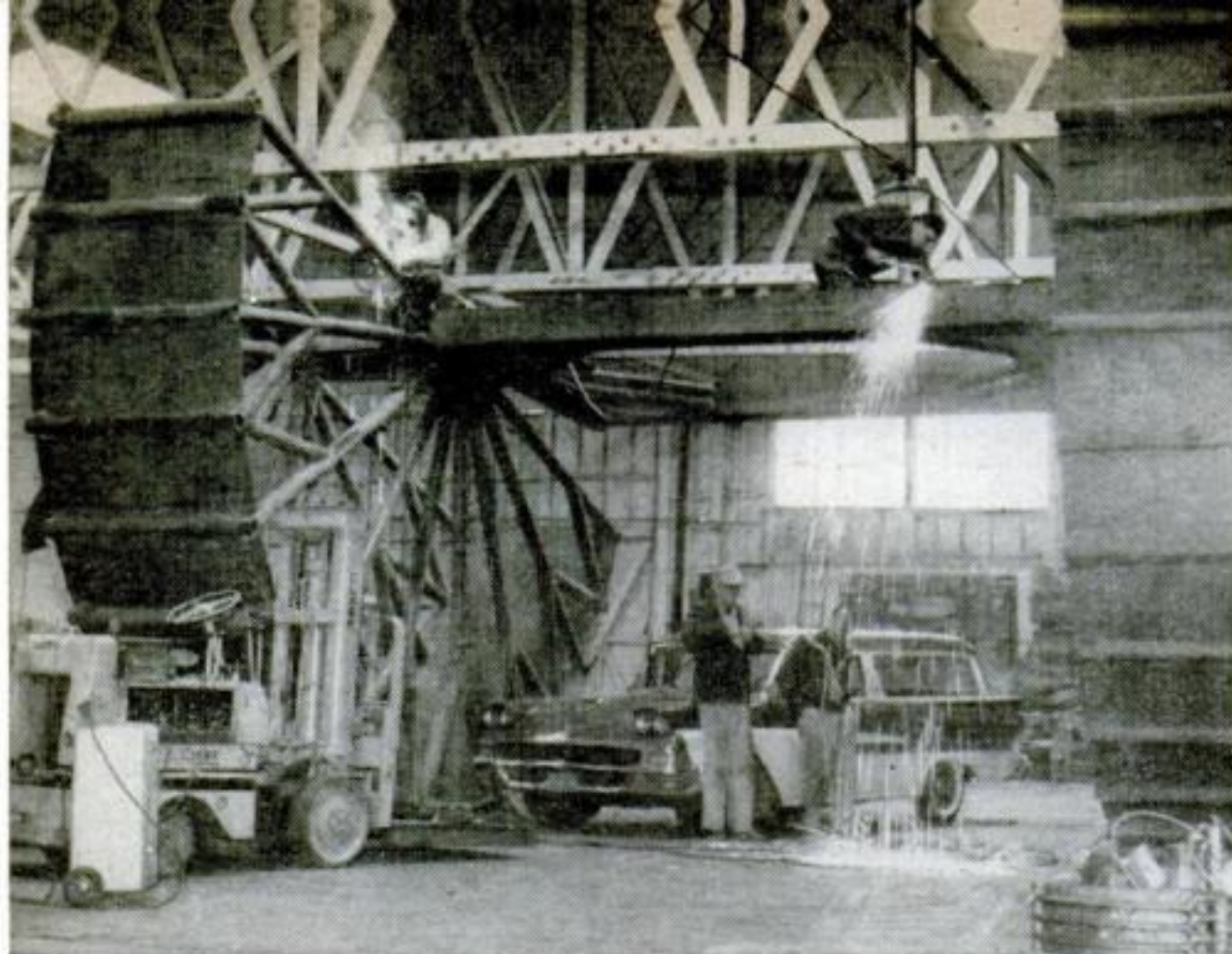
Their interest focused on a former cannery at the north end of the main street. Over its porch is nailed a broad sign that reads "Bunyan Buggy." Inside the old cannery, a fantastic vehicle of enormous size has been slowly taking shape. Just about everybody in town has dropped in from time to time to watch it grow.

Basically, the Buggy is a two-wheeled, self-propelled cart for hauling logs (meaning, in this instance, tree trunks up to 40 feet long). But what wheels it has! They are 24 feet in diameter—taller than many a two-story house—and five feet wide. They can cover a mile in only 70 turns. And those great, spoked wheels are designed to support payloads of as much as 120 tons, slung below the frame of the

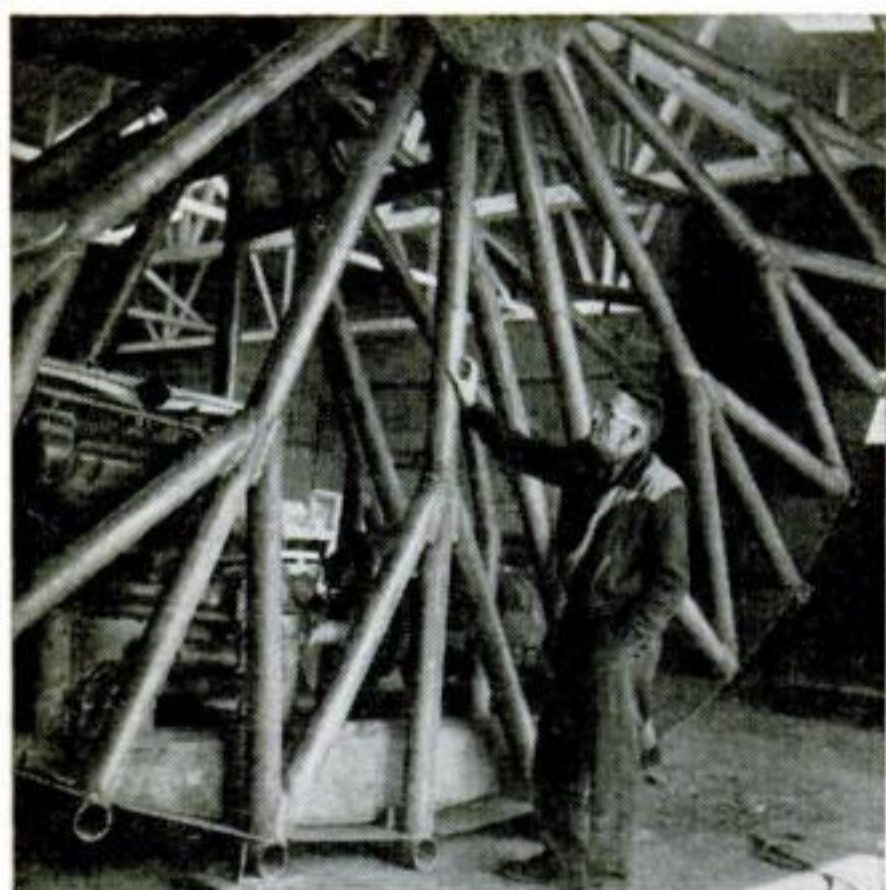


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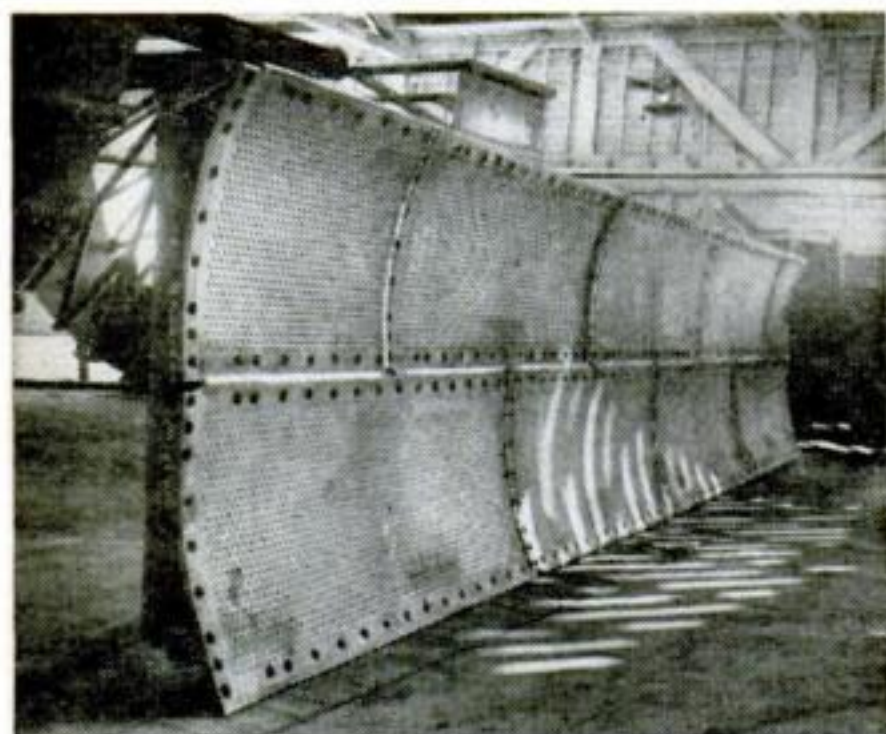




**SPARKS FLY** from welding torches as mightiest tractor is assembled by inventor Manning and his helpers in Isleton, Calif., building formerly used as a cannery. Welders are working on frame linking the half-completed drive wheels, so large that they will cover a mile in only 70 revolutions. Designer has improvised this prototype with parts from junk yards, including oil-well drill pipe for wheel spokes.



**TWO-STORY-HIGH DRIVE WHEEL** towers above its designer, Harold Manning, as he inspects it.



**BULLDOZER BLADE**, which also serves as six-ton counterbalance, is ready for installation.

Buggie. The vehicle itself weighs 38 tons.

Because this giant cart seems far too big for human beings to use, and is intended mostly for work in the woods, its inventor, Harold Manning, naturally thought of naming it for the mightiest woodsman of them all, the legendary Paul Bunyan.

Manning, 56, has been a logger since 1922. He has wrestled tractors up and down lumpy, stump-dotted, steep slopes almost as long as he can remember. And he says, quite flatly, "Cats have gone as far as they can go."

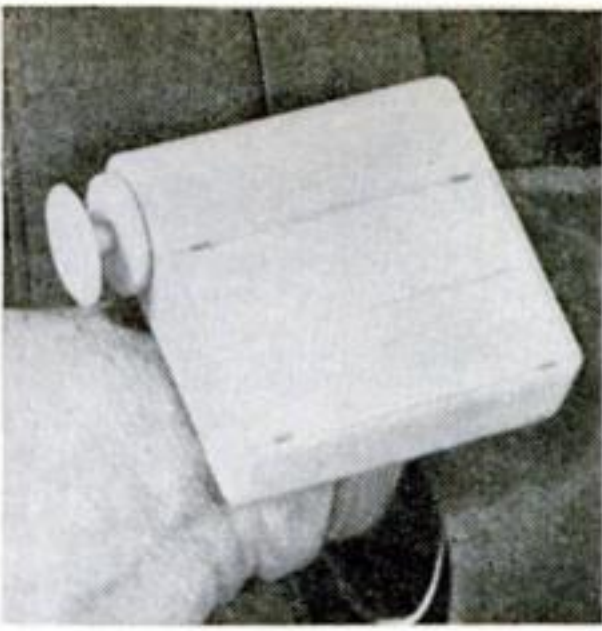
"A cat doesn't get a particle of traction out of its load," Manning explains. "That's because it doesn't carry, it pulls. Now, with my Buggie, the bigger the load, the greater the traction. With a load of 120 tons, it'll go up any hill that the biggest cat can go up without a load."

*Two 500-hp. engines*, Ford V-8s, stripped from Army medium tanks, are inside the Bunyan Buggie's wheels. They are protected from ground water and debris by steel sheathing that extends six feet in from the rims. One engine is hung from each axle, and remains fixed while turning the vast wheel around it by means of a five-ply chain drive. The chains run from an engine cross-drive up to a 12-foot sprocket around the axle.

Each engine is mounted on a crescent-shaped base of sheet metal, formed to fit the curve of the wheel. The base contains a 700-pound gyroscopic stabilizer and an 85-gallon fuel tank. Its curved bottom is covered with heavy-duty brake lining.

*[Continued on page 208]*





**WORKING MODEL** above will be replaced by curved case that fits the wrist like a watch.

**INFLATED BALLOON** will keep an exhausted swimmer afloat as shown in the photo at right.



### **Wrist life preserver**

A personal life preserver that straps to your wrist like a watch has been invented by two U. S. Marines. The Leathernecks are Gunnery Sgt. Daniel O. Davis, serving at Camp Lejeune, N. C.,

and his veteran buddy, Landon McGill, now a watchmaker at St. Pauls, N. C. They have encased an elastic bag in a small plastic container with a replaceable carbon-dioxide cartridge. The CO<sub>2</sub> blows up the balloon when released by button in an emergency, floats it on the water.

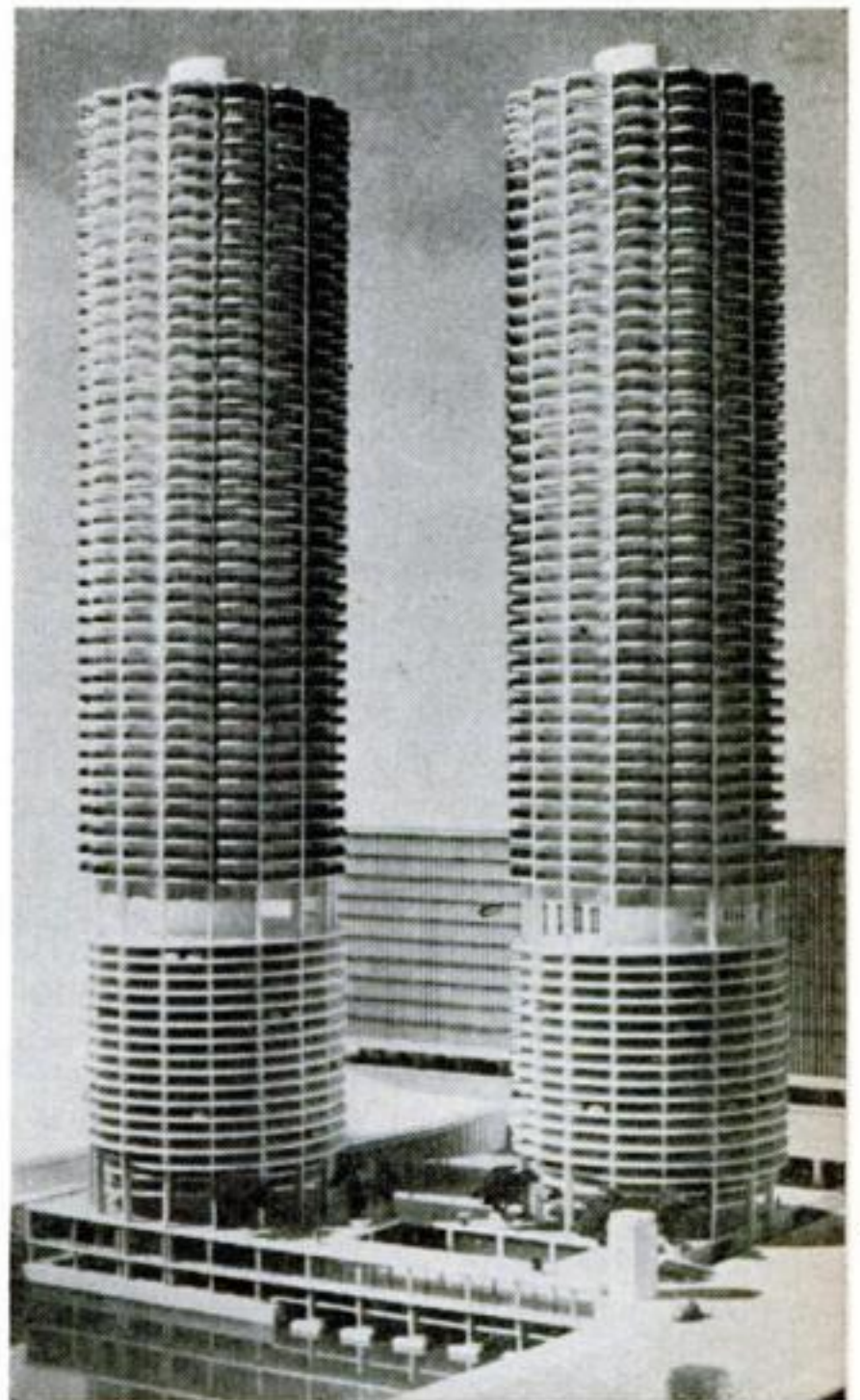
### **Tallest apartment house**

The world's tallest apartment house—60 stories—will rise in Chicago's Loop. Twin circular towers (model at right) will contain 896 apartments, each with balcony, radiating from an elevator core. The first apartments will be on the 21st floor; a 900-car parking ramp will spiral around the lower 18 floors. Called Marina City, the project, including office building at rear, is being financed by the Building Service Employees Union.



### **High-riding tractor**

Having a tractor that was slung too low to ride over crops without damaging them, Charles Howard, a nurseryman at Hemet, Calif., gave it a lift. He welded hollow steel blocks to the track cleats to raise the machine. A bar at the center of each prevents slippage to the sides.





## WHAT'S NEW.....

### Mower Can Flush Out Clippings

A new gas rotary power mower cleans itself when you attach a hose to a built-in coupling, turn the water on, and run the motor for a minute or so. It also has a leaf mulcher. With 3-hp. motor, \$139.95; 2½-hp., \$112.50.

A piggy-back spreader for seeding, liming, fertilizing, or killing insects or weeds while you mow comes for \$14.95 extra. Sunbeam Corp., 5600 Roosevelt Rd., Chicago.



**PROPANE SCRAPER** blisters off old paint as you scrape. The basis of this new tool is the familiar hand-held propane tank available for several years with other appliance attachments. You use it with one hand instead of having to hold a blowtorch with one and a scraper with the other. Hot Blast Paint Scraper, \$9.95; replacement tank, \$1.95. Turner Corp., Sycamore, Ill.

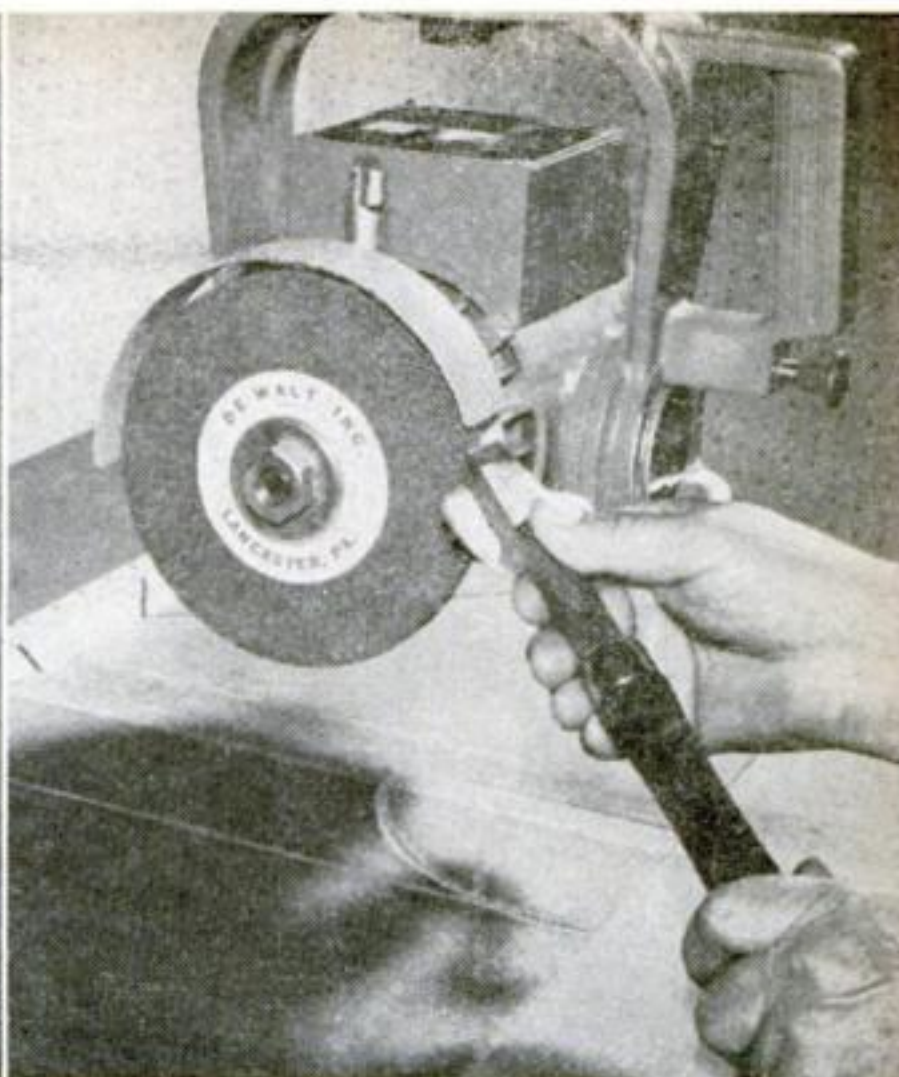


**NONREFLECTIVE TAPE** for permanent mending of torn blueprints, maps, books, and other papers is colorless and almost invisible. The Scotch brand tape is made of acetate film with a matte finish that you can write on with a pen or pencil. Unlike other tapes, it doesn't discolor with age. A 180-inch roll sells for 39 cents. Minnesota Mining & Mfg. Co., St. Paul, Minn.





**REFRIGERATOR DRAWER** holds and keeps fresh a week's supply of meats and vegetables without freezing and has room as well for beverages and fruit. It glides out smoothly for access to its contents so you don't have to open other compartments. Above it is a refrigerator unit and below a freezer section. Westinghouse Electric Corp., Pittsburgh.



**GRINDING GUARD** fits over wheel mounted on a radial-arm power saw. You clamp it to the motor end bell with its stud and wingnut. The kit consists of a bracket, tool rest, and two guard shrouds—one for grinding, buffing, and wire wheels up to six inches in diameter, the other for cup wheels up to four inches. \$9.95. DeWalt Div., Lancaster, Pa.



**NEW TIRE GAUGE** is equipped with a flexible white nylon pressure bar that won't break or kink, seize or rust, and requires no lubrication. Its black numerals are easy to read. Price, \$1.29 to \$3.98. Sears, Roebuck & Co., 925 S. Homan Ave., Chicago.



**CURRENT TESTER** lights a bulb in its end when you touch it to the live side of an outlet, appliance, switch, spark plug, or ignition coil. It's the size of a ball-point pen and tests 110 to 550 volts. It costs \$1. Hahn Co., 2311 Fox Hills Dr., Los Angeles.



**PEDAL HOLDER** is attached at one end to the dash; the other depresses the accelerator and can be adjusted to any speed for tune-ups. It will be useful next winter, too, for warming up a cold engine. \$3.95. Cizek Mfg. & Distributing Co., Clutier, Iowa.



## WHAT'S NEW.....

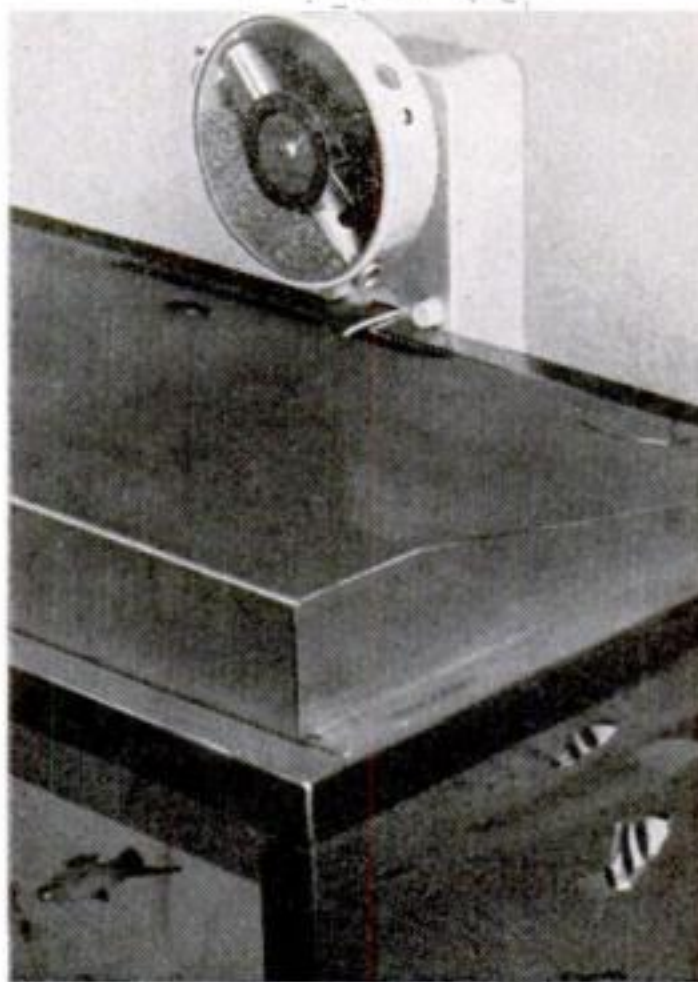


### Magnetic Door Latch

Plastic stripping containing a strong magnetic material is now used in the edges of combination screen and storm doors. In case you don't close the door all the way, the flexible stripping will pull it tightly shut. Doors come in 18 styles. Weather-Seal, Inc., Barberton, Ohio.

### TRACKED-DOOR HARDWARE

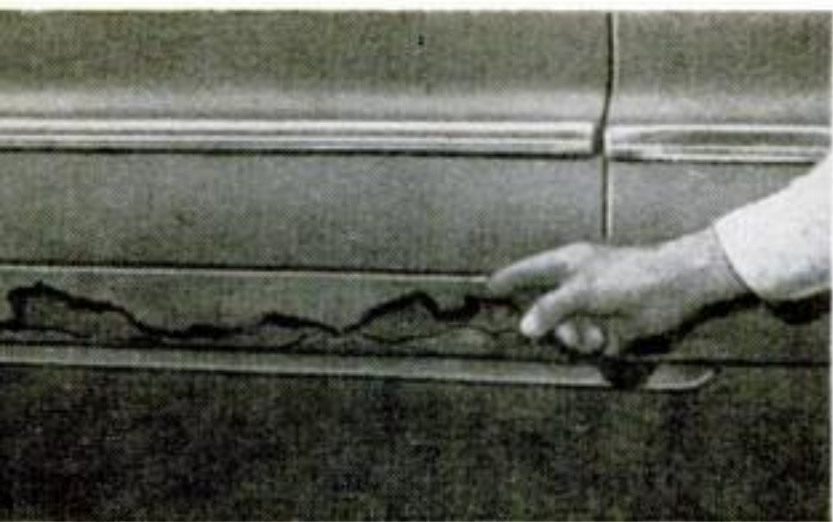
and hinges mount on the surface, let you convert an arched recess into a closet, and cover the entire opening. No jambs or trim are needed. The hardware can be used on doors of any height. The Stanley Works, 111 Elm St., New Britain, Conn.



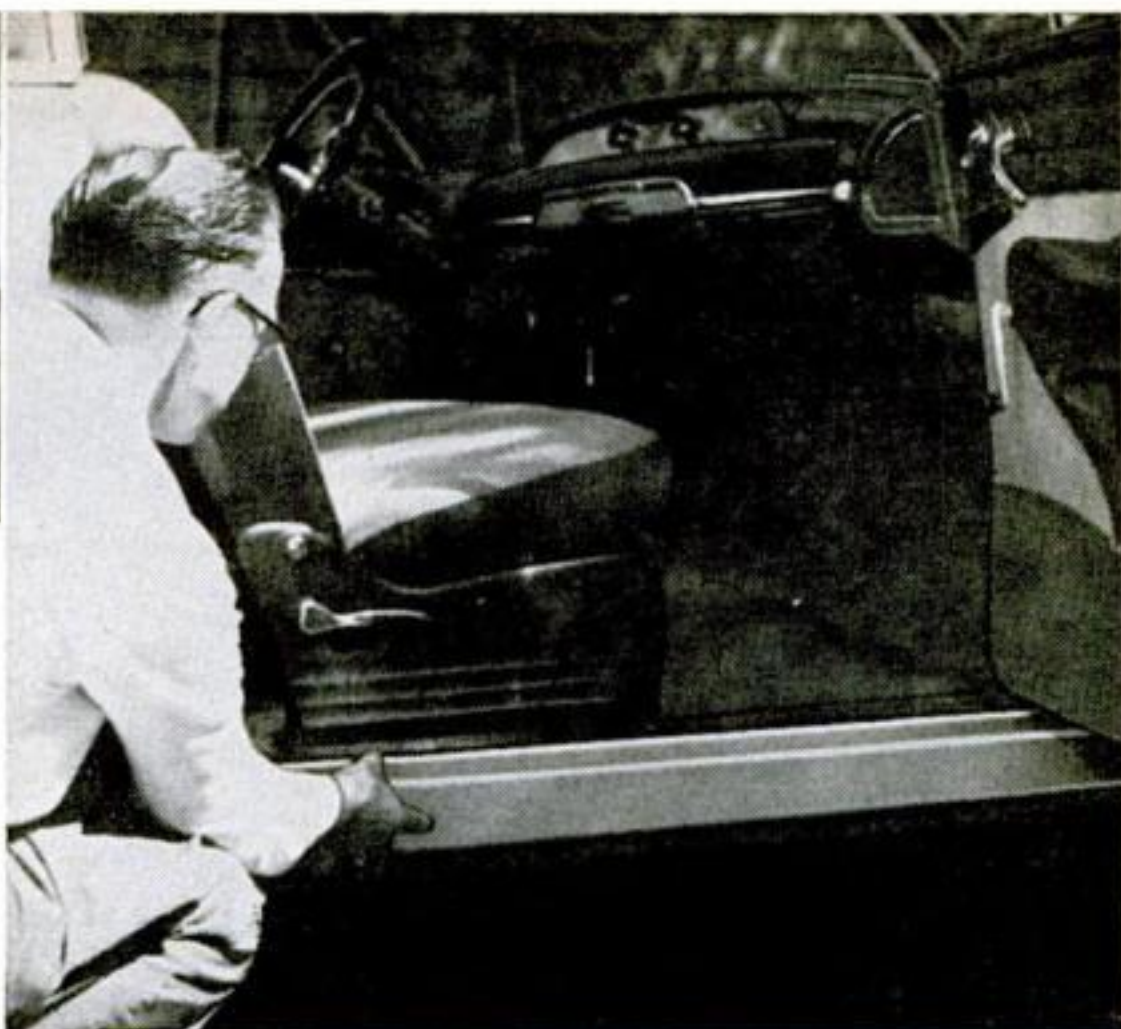
**FISH FEEDER** runs like an electric clock. Its food drum revolves once in 24 hours, and a tube in the center picks up an adjusted amount as it turns, dispenses it in the fish tank at any set time. \$16.95. Era Products, 261 Thrift St., San Francisco.



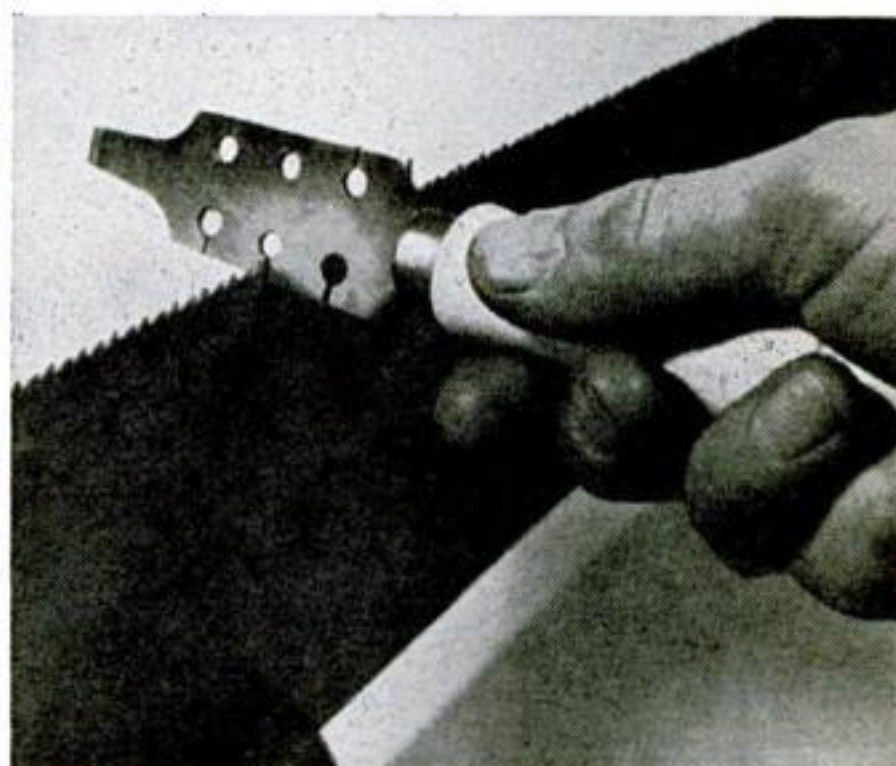




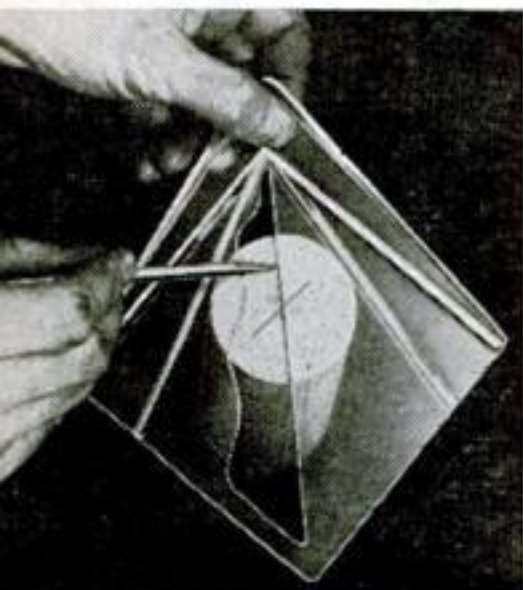
**ROCKER PANEL** can be put on over an old rusted one to give your car a new look. Factory-treated replacement needs no conditioner or primer before being painted. You must specify car make, model, and year. Two-door, \$7.95; four-door, \$9.95. Richline Co., Minneapolis.



**CORNER SINK** has stainless-steel bowls at right angles, one for each wall. Faucets in the corner will fill either. The double sink was designed for small kitchens with little wall space. It measures 22 inches in depth. Jensen-Thorsen Corp., Addison, Ill.



**SAW SET** is a simple hand tool with which you bend teeth to restore the set. Clamp the saw in a vise and bend the teeth alternately in and out. The tool has six setting slots of different widths. Price, 79 cents. Industrial Products Sales Co., 1182 Broadway, NYC.



**CENTER FINDER** is used to mark squares, hexagons, and octagons as well as round work. It's made of clear Lucite plastic. \$1.95. Athens Fabricating Co., Athens, Ga.

**FLIP HOSE NOZZLE** can be pressed right or left with the thumb to regulate spray while you hold it by finger grips. It's chrome-plated metal. It sells for \$1.59. Franklin Metal & Rubber Co., Hatboro, Pa.







### *The machine is set up*

by mounting the camera-computer box on a tripod in front of a parked car and hooking up two 12-volt car batteries (left). Box is aimed at the center of the adjacent lane, 20 feet down the street. At this point (above) two pressure-sensitive tapes are glued to the road and connected by wires to the box.

# Cops' Camera Catches Speeders in the Act

**New electronic trap—computer, camera, and strobe—makes speeding a tough rap to beat**

**By Erik H. Arctander**

**A** BOX that looks like a 17-inch TV set promises to be the ultimate weapon in the war on speeders. This newest speed trap, Foto-Patrol:

- Is almost impossible to spot.
- Picks out only cars that exceed a preset limit and ignores all others.
- Computes the speed of a violator's car to an accuracy of 1/10 m.p.h.
- Produces a photo for evidence that gives all the details of the offense.

One policeman can set up the 35-pound box, batteries, and tapes in five minutes. Turning the speed-setting knob to the speed at and above which he will issue summonses, the cop flips on the power switch. He walks 300 to 400 feet in the direction traffic is moving and waits.

Nothing happens until a car exceeds the speed setting—usually five m.p.h. over the legal limit. When one does, the powerful strobe light on the front of the box flashes a split-second after the front wheels of the speeding car cross the second tape. Alerted, the policeman waves the offender over and hands out a ticket.

*Inside the Foto-Patrol box* are three units: a transistorized analogue computer, an automatic camera, and a strobe.

The computer measures how long it takes a car's front wheels to travel three feet—from one tape to the other. It translates this time, in thousandths of a second, into miles per hour. The computer works so quickly that before the car's rear wheels reach the tapes it has the answer. If the speed is at or above that set by the policeman, the computer triggers camera and strobe light electrically and they take the car's picture.

The custom-made 35-mm. camera has a three-element, fixed-focus lens with a 1/1,600-second guillotine shutter. It can





***Speeder sets off camera and strobe***

by covering the three feet between tapes too fast. Analogue computer converts the elapsed time into miles per hour and trips the photo unit, which snaps rear of car.

***Cop pulls the speeder over***

300 to 400 feet farther on. Strobe light, which flashed while speeder's car straddled tapes, tagged him as a violator.

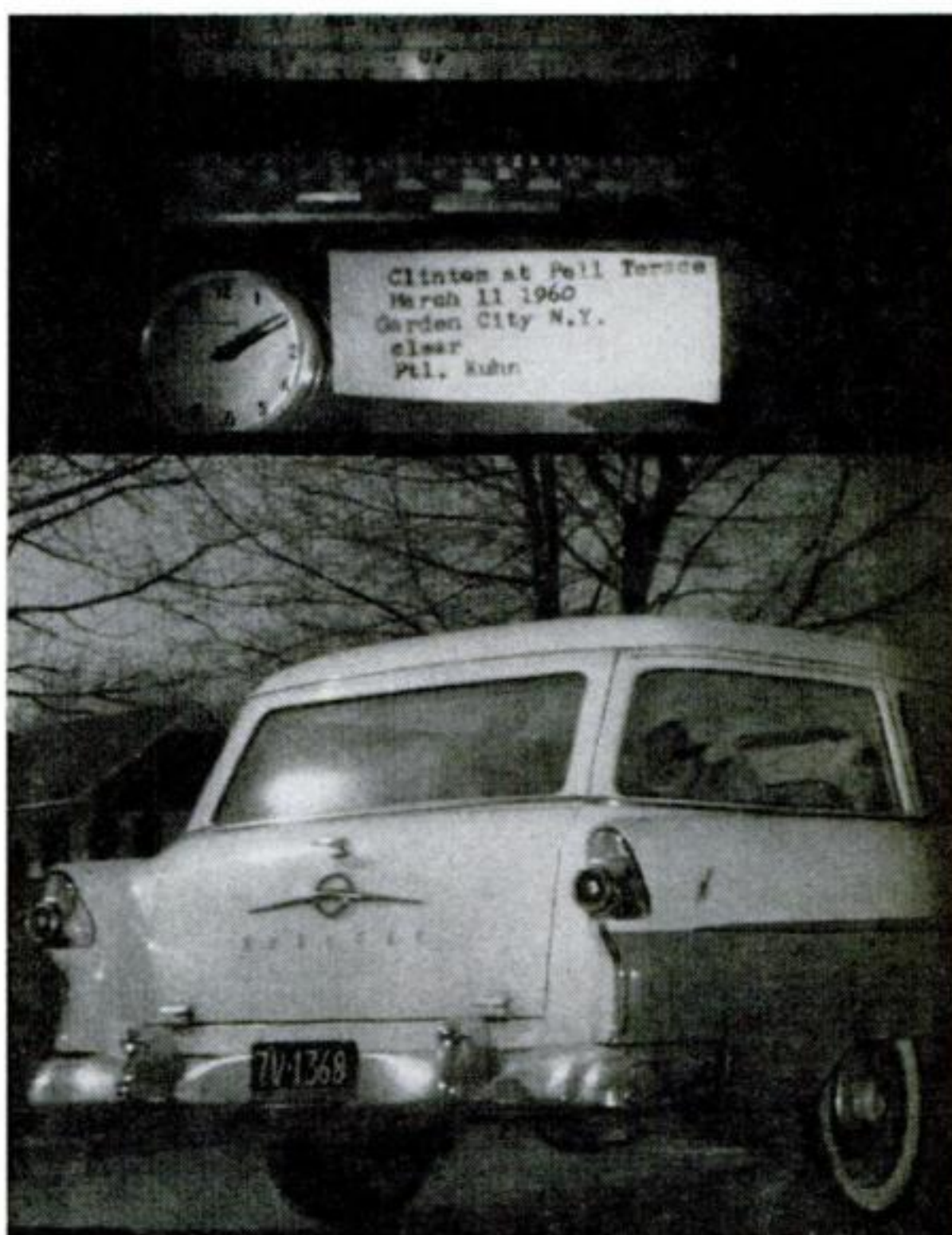


***Handing out ticket,***

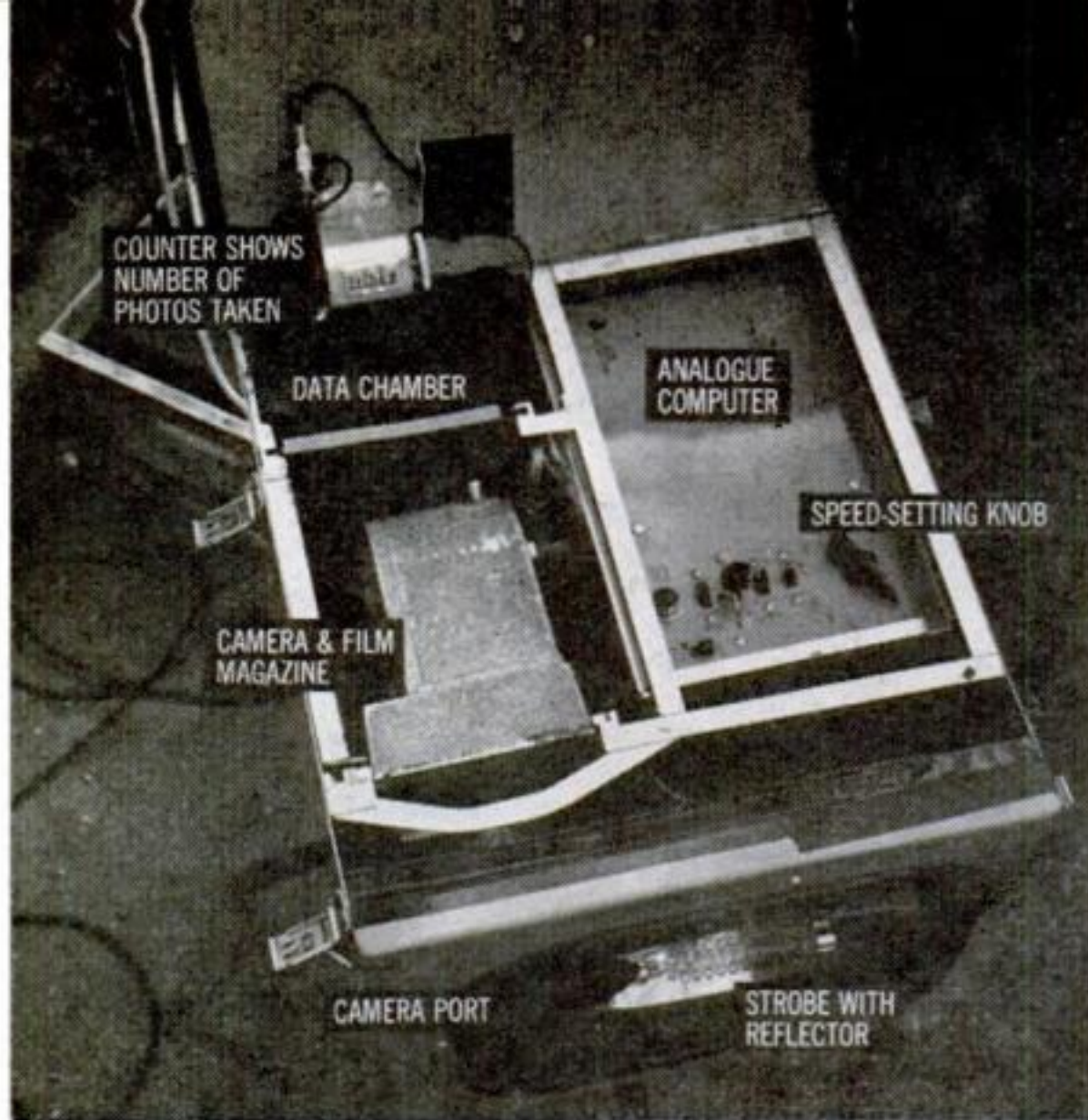
officer charges only that the driver was exceeding limit; exact speed is filled in later.

***Photographic evidence***

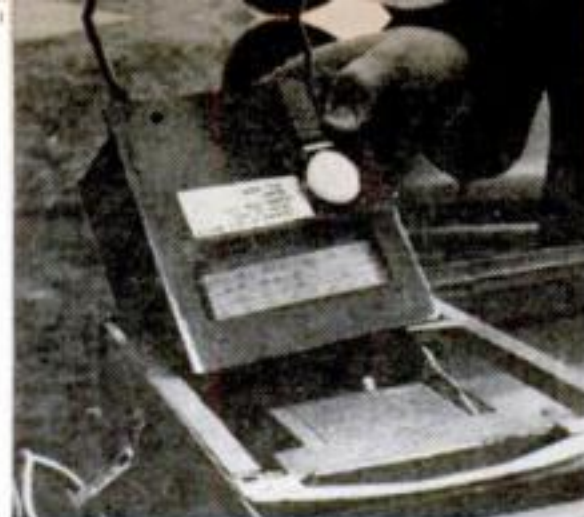
is produced in court if the speeder fights ticket. Photo shows—bottom to top—rear of car with license plate, watch showing time of offense, data slip, light pattern made by computer read-out, speed scale (upside down). Scale indicates speeder was doing 48 m.p.h.



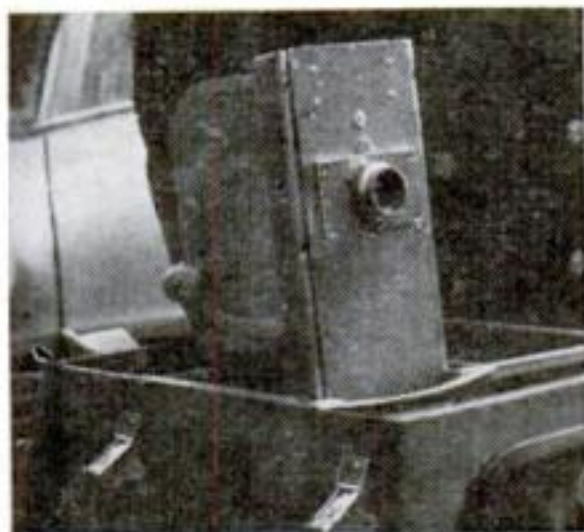




**INSIDE THE FOTO-PATROL BOX** are three removable units linked electrically: a computer, camera, and data chamber.



**DATA CHAMBER** has information slip, watch, computer read-out.



**SPECIAL 35-MM. CAMERA** shoots 100 feet of film automatically.

take 1,000 pictures automatically on a 100-foot roll of Kodak Tri-X film.

While the shutter is open, the synchronized flash tube fires. Peak illumination lasts for 1/5,000 second and the curved reflector throws light over a 10-by-10-foot area 35 feet away. Some light also spills into the data chamber in the bottom of the camera and illuminates the speed scale, a watch, and the typed slip of paper. These are reflected by mirrors into the lens and recorded on the top third of the frame; the car's picture fills the other two-thirds.

*The idea for Foto-Patrol* originated with Leon Perl, an energetic, persistent New York lawyer. His job of settling auto-accident claims for the U. S. Fidelity & Guaranty Co. convinced him that speed is a big factor in most accidents.

No engineer himself, Perl split his invention into units and had each one developed separately by different experts. At first only he knew how they would be combined and used.

Perl tried out a prototype model in Port Washington, N. Y., during May, 1956. Of 14 summonses issued, 12 were

contested. All 12 defendants were convicted.

It's the photograph produced by the machine that makes policemen enthusiastic. It gives the complete, accurate story of an offense without complicated interpretation or expert testimony. And there is little chance of mistaken identity—offender and offense are linked.

Another feature is the device's versatility. It has timed speeds from 10 m.p.h. to 110 m.p.h. with 1/10-m.p.h. accuracy. The strobe is so powerful and the camera shutter so fast that good photos can be made in bright sunlight or on a dark, rainy night.

Foto-Patrol won't be sold, but will rent for \$15 a day. The charge covers film, processing, prints, servicing, and repairs.

Improvements are still being made. The production models, now coming off assembly lines, will have a simpler speed indication than the one shown here. A remote read-out may be added later for distant monitoring of the machine. Work has already started on a model that will cover three lanes in the same direction simultaneously without a mixup.

## Next Month: Unmarked Police Cars

*A sneaky trick or a fair and effective weapon against traffic violators? July Popular Science gives you an on-the-scene report.*



## Catapult cuts jet runway

This two-part machine is designed to put jet planes into the air with a takeoff speed of 150 m.p.h. from a runway less than 5,000 feet long. This would permit them to gain altitude fast and thus reduce ground noise during takeoff.

A jet would be trundled onto a U-shaped lead vehicle with rear landing wheels on the legs of the U. The main unit would then be nosed into the U.

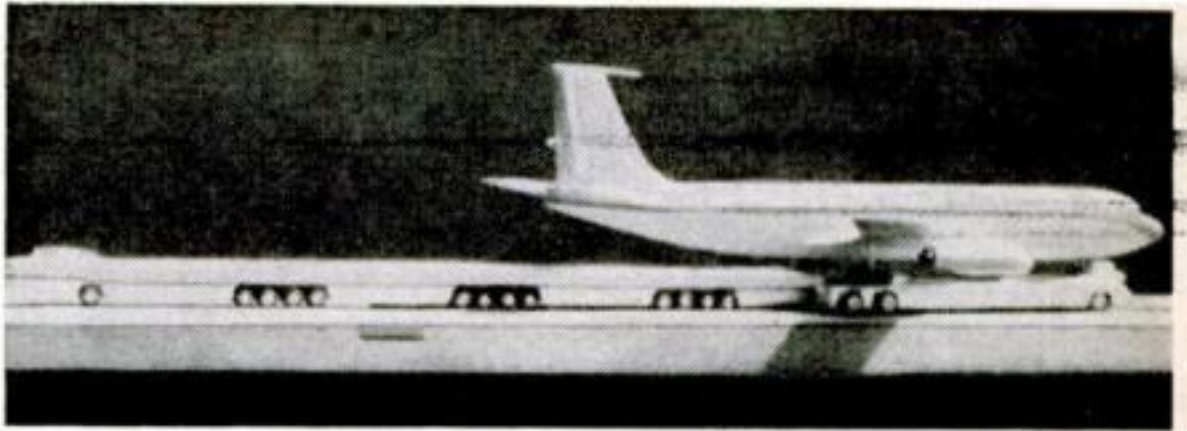
The two ground vehicles would run on both airplane-tired wheels and almost-horizontal flanged wheels that engage a pair of rails turned on their sides and sunk flush with the runway surface. The flanged wheels would prevent sway.

Both vehicles would be propelled by diesel-electric engines, those on the front developing 2,000 hp., those on the rear 4,000 to 6,000 hp.—a combined takeoff force of up to 8,000 hp.

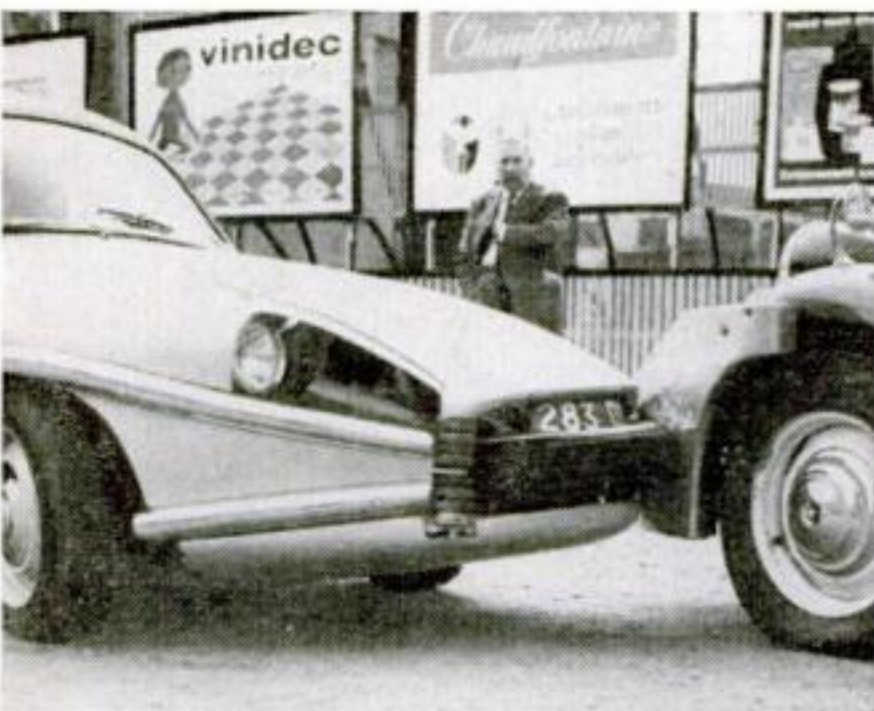
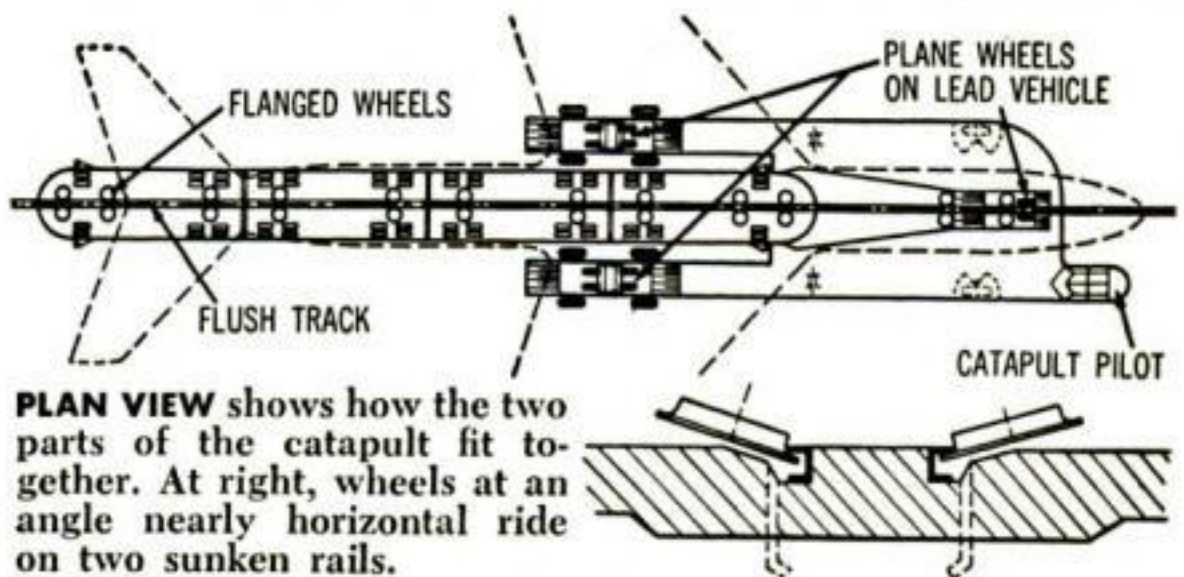
The machine was designed by a German engineer, Heiner Kuch of Nuremberg.



Model shows a jet plane in place on the lead takeoff vehicle.



Main propulsion vehicle then noses between the legs of the U.



## Dual-purpose fifth wheel

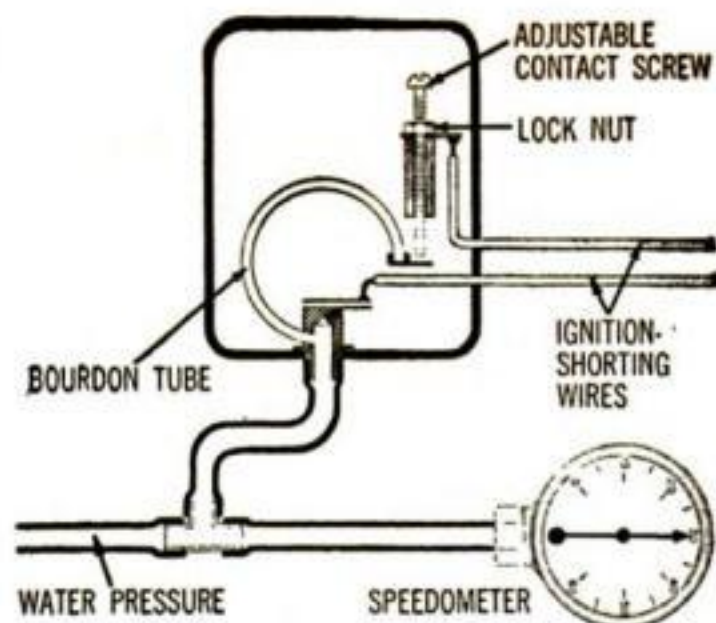
The extra tire on this car is not just a spare—it's a bumper, too. Mounted at the front of the hood, it cushions impact in a collision. It's the idea of Jacques Jean Marie Gerin, French inventor.



## Off for a hayride

Five sliding prongs at the bottom of this British hay carrier pick up bales from a field. Gates on either side then close to hold a stack of 20 in place behind a tractor for carting to the barn.





**CONTACT SCREW** set for top speed shorts motor when speed is exceeded.

**SPEED LIMITER** is the box at right on the panel mounted on the afterdeck.

### Speed limiter for water skiing

The governor shown here will keep the speed of power boats constant—plus or minus .5 m.p.h.—for water skiers in competitive runs.

It consists of a Bourdon tube connected by a tee to the water-pressure line from the impact tube to the speedometer. The

Bourdon tube tends to straighten out as water pressure increases, causing a short in the ignition circuit to the motor until pressure is again relieved. A contact screw in the shorting circuit can be adjusted to any top speed. The governor can be used with either outboards or inboards. It is made by Aqua-Meter Instrument Corp., Roseland, N. J.



### Bubble roof

Row on row of glass domes (left) admit light to the central waiting room in a passenger terminal at Kastrup Airport in Copenhagen, Denmark. A total of 200 bubbles dot the big roof.



Late bulletin is put in TV news scanner.

### Closed-circuit news flashes

Closed-circuit television now links news room with studio at the British Broadcasting Corp. The script is placed under



Last-minute scores are read by announcer.

a scanning camera and reproduced on a monitor on the newscaster's desk while he is on the air. The system speeds telecasting of last-minute news, sports scores, police and traffic bulletins.



# What You Should Know About Towing a Trailer

***Driving is different when you hook a trailer on your car.***

***Here are some tips that will make it easier—and more fun***

**By Phil McCafferty and George Laycock**

**I**F SPRING fever lures you onto the highway for the first time with a camping trailer loaded with gear, or a boat trailer cradling a new outboard, you'll be in good company. There will be nearly two million boat trailers on the highway this season, let alone all the other kinds.

If you should try your hand at saving money on moving expenses by renting a one-way utility trailer, it will be one of the couple of hundred thousand that shuttle

in ceaseless orbit around the country.

Driving conditions change the moment you drop a trailer coupler over the hitch ball on your car. For the first 25 miles you'll be as conscious of that trailer behind you as you would be of the Hope diamond hanging around your neck. But you'll soon get used to it. Here are some points to remember that will make trailer-ing safer and more fun.

- In the eyes of the law, in most states, you are no longer a passenger car but a



**SIDE-VIEW MIRROR** is a must for safe travel with a trailer. A tow often hides the road from a standard rear-view mirror. This car is equipped with two for extra vision.

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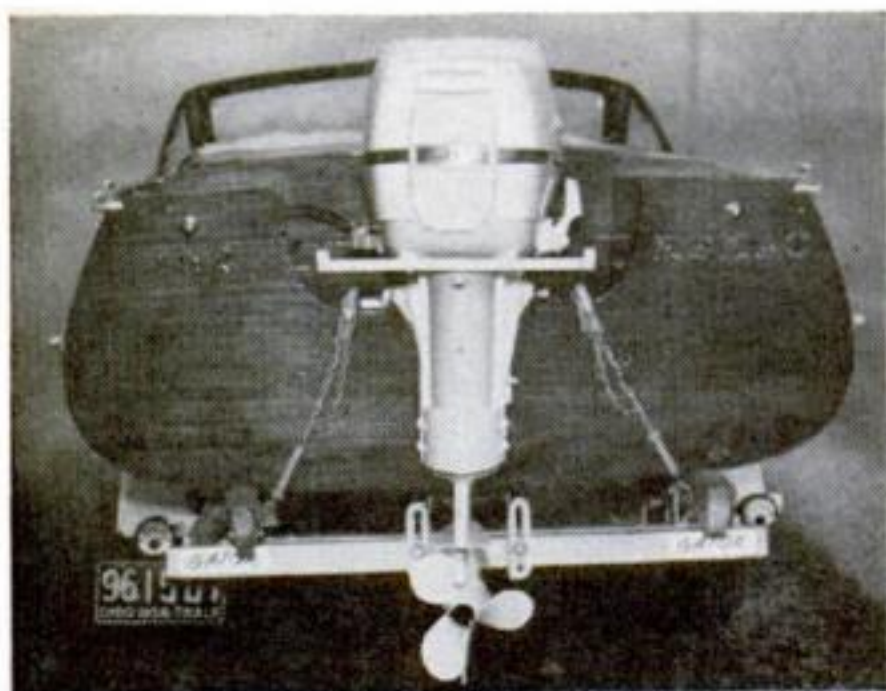
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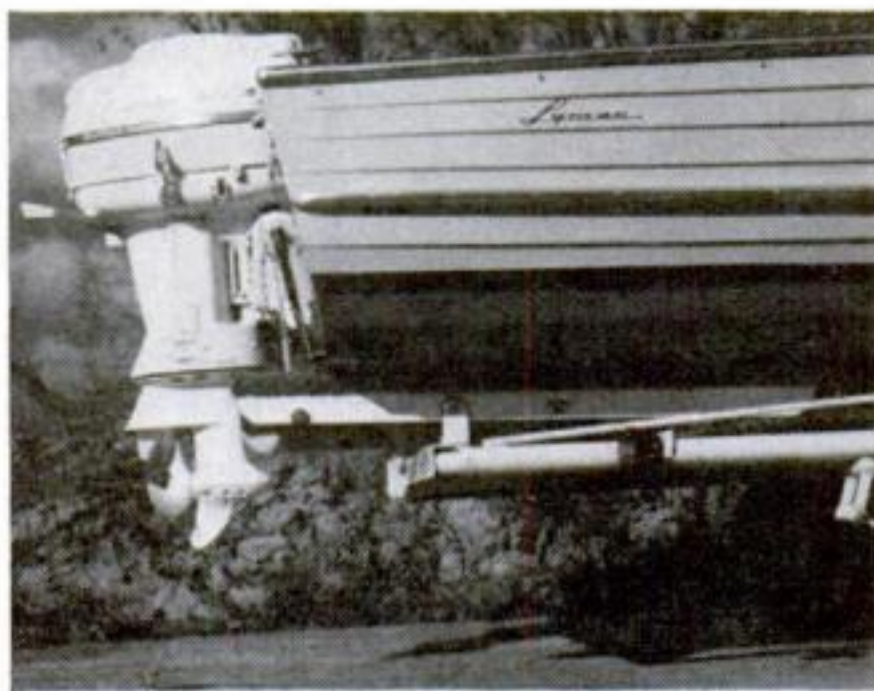


**ON THE OPEN ROAD**, allow yourself plenty of room. Keep the speed down, and don't make

sudden changes in direction—or speed. Boat-trailer sway means that it is loaded stern-heavy.



**DIRECTIONAL LIGHTS**, shown in this rear-view close-up, are a good idea. So are reflector strips on the outside boat edge and on the fenders.



**SUPPORT TRANSOM** under motor by adjusting trailer, as shown above, so that dead weight won't damage boat. Use pads to protect finish.

multiple unit, and frequently subject to special laws.

- Passing is difficult. You are twice as long as you were, and you need twice the space to get back in line. Besides that, nearly all of your car's former zip for passing is gone.

- If your brakes are in average shape, you can stop your *car* on dry pavement at 50 m.p.h. in about 20 car lengths. Pulling a medium-sized trailer stretches

stopping distance to 25 or 30 car lengths.

- If you're a gas-mileage estimator, revise your bench marks. Depending on trailer weight and shape, your mileage will be cut anywhere from 10 percent to more than 50 percent.

- While your trailer tires may be much smaller than the super-softies on your car, they'll need two or three times the air pressure.

- Your standard auto personal-liabil-



**ON LAUNCHING RAMP**, keep the trailer under constant control. Its weight may pull your car

into water if rear wheels spin. Be extra careful on wet surfaces. Pull out in low gear.



ity and property-damage insurance will likely cover you when pulling a trailer, but load it with sweet corn or strawberries from your garden *for sale*, get in an accident, and you've had it!

The sheer increase in weight, the addition of two more tires, and the added length and air resistance are the chief reasons a trailer needs added respect on the highway. It is time well spent if you can play around getting used to how these factors affect car handling *before* you get into traffic.

Get the feel of the additional distance required to stop. Is there any tendency for the unit to snake or whip when brakes are applied? Know how to cope with the effect of a sudden crosswind or the violent vacuum immediately following a passing semitrailer or bus.

Try a few corners and curves. They need less speed and more steering. Learn how your increased weight affects momentum going downgrade. Find out how steep a hill you can negotiate without needing to go into low range, second gear, or out of overdrive, while still maintaining full control.

Perhaps most important of all is learning just how much less passing pickup you have, how many more car lengths are needed to pass and get back in line without whipping.

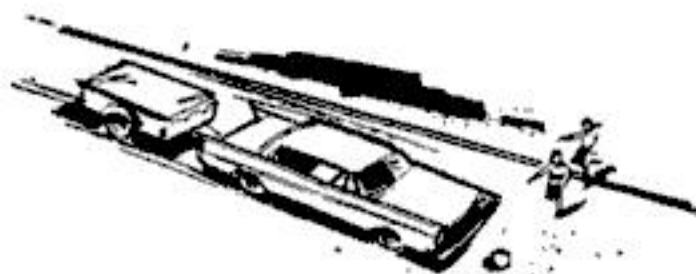
**Figuring the odds.** Actuaries for the insurance companies are betting you won't get into trouble pulling a trailer, because they usually allow it without extra charge. Somewhere in the fine print of your auto policy, however, they spell out the extent of their liability. Check yours; policies vary.

You'll probably need to buy special insurance, on a short-term basis, if you use your trailer for any commercial purpose. Short-term coverage is a money saver on trailer collision insurance, too. If you use your trailer for an annual vacation trip, insure it for the 30-day minimum period only.

Rental trailers, either local or long distance, round-trip or one-way type, are available to haul just about anything: furniture, appliances, building materials, horses, and boats. And there are specially rigged trailers just for vacation camping.

Charges are pretty much standard in a given city. What you should know, before

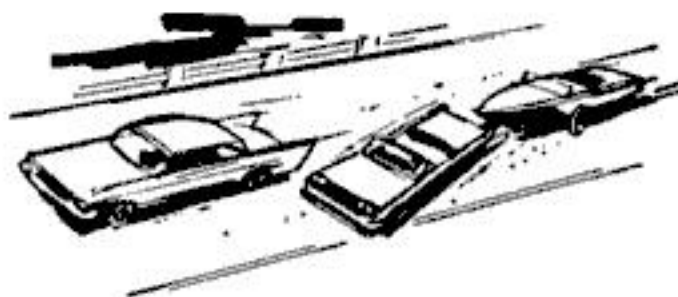
## Trailer-Travel Reminders



**ALLOW MORE TIME FOR BRAKING:** You won't stop as quickly with a trailer.



**CHECK YOUR TRAILER RIGGING** at gas stops. Things have a way of working loose.



**PASSING ZIP IS GONE,** and you'll need twice the space to get back in line.

you sign a contract, is: What's included in the price?

Find out how much, if any, insurance the owner is providing on your cargo. Rental firms will probably carry their own collision insurance on the trailer itself. Again, check your own auto insurance to see if it covers your hauling a rented trailer.

If you plan to haul furniture or appliances on a trailer, find out if padding, tarps, and dollies are included in the quoted fee.

Flat tires are not at all uncommon on heavily loaded, small-tired trailers, so find out who pays for repairs, and if emergency road service is provided.

You should expect the rental agent to install an adequate hitch on your car, hook up the trailer, check tire pressures, and provide legally sound lights, license, and equipment.

Some outfits stencil "SPEED LIMIT 35" or some such sign on their trailers. Best have them spell out the extent of their

CONTINUED

III





**BATHROOM SCALE** is handy for checking weight that will rest on trailer hitch. It should be about five percent of light loads, not more than 100 lb., to lessen bounce and make driving easier.

responsibility if you get into trouble at a higher—if legal—speed.

Make sure you can go where and when you wish and leave a one-way trailer. At rush seasons, one-ways pile up in a few popular states. To distribute their rolling stock, some firms temporarily restrict the places where you can leave their rigs.

Little things and habits you might not give a second thought to become important when towing a trailer.

- Trailer-wheel bearings, particularly those on small-tired boat trailers, need a grease-pack job about every 3,000 miles, more frequently than car wheels, because they turn more times per minute. If you immerse a trailer over the axle while

launching a boat, better have the bearings flushed and repacked.

- Check your car's automatic-transmission fluid level occasionally and note any band slippage or overheating when driving in hilly country.

- Consider value when you choose the portion of your luggage to stow in a tarp-covered boat hull or trailer box. Invitation to theft while parked is great. And don't exceed the allowable gross weight just because there is room in a boat hull.

- Lashed-down tarps, boat hulls, and heavy appliances have a tendency to work loose in transit. Check rigging after driving 10 miles, and each time you stop for gas. Ease tension on boat tie-downs when you stop for the night. Remember, manila ropes come and go with humidity, rain, and heat. It's okay to tow a boat with the motor in a vertical position on the transom. But tie it down securely enough so it can't swing out when you hit bumps, yet in such a way that the tie will break if the prop guard hits a high intersection crown.

- A packet of iron-on dungaree patches is handy on trailer trips for quick repair of tarps damaged at wear points.

- Before you start on a trip, check to see if your jack will lift the trailer for a tire change. Many won't. Be sure your lug wrench is the right size. Leave the trailer hooked up for a tire change.

- Grease the hitch ball. Friction on a dry ball can heat it until it cracks.

- Litterbugging in the form of throwing cigarette butts out the window can be embarrassing. The hot butts invariably head right for the trailer. A forced-draft direct hit in a tarp or fuel-soaked area can bring a vacation or moving trip to a spectacular, if premature end.

## Trailer Towing and the Law

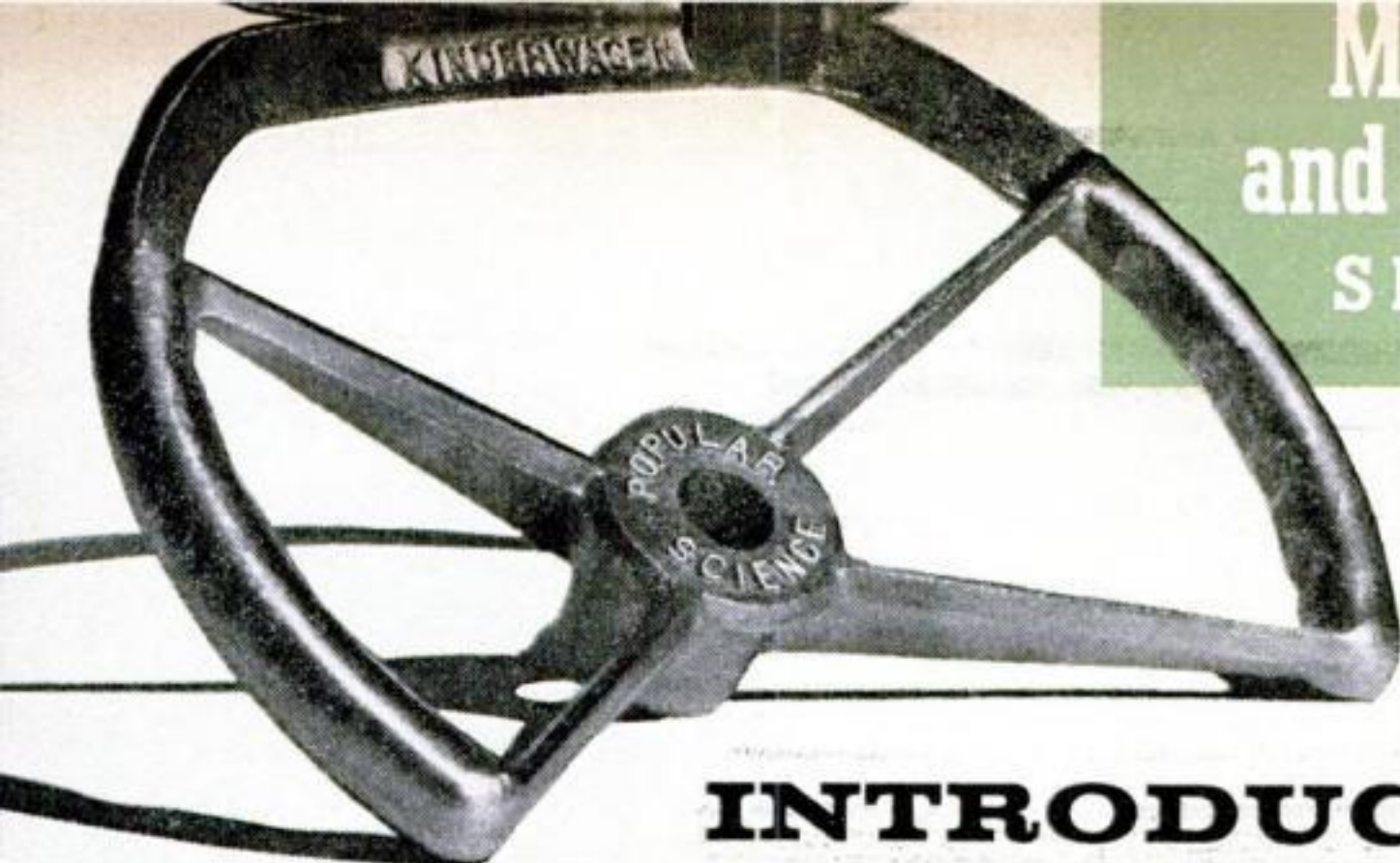
Many of the laws regulating trailers were obviously designed for semitrailer trucks and house trailers. Nonetheless, in most states, they also apply to the smallest utility trailers.

Your state highway-patrol station can tell you the legal requirements in your state, often the differences in laws you might encounter in other states.

Most states have laws regarding:

- Speed limits
- The highways you can travel
- Tail lights
- Turning signals
- Outside mirrors
- Safety chains between trailer and car
- Tire chains (for car, in winter)
- Load width, height, gross weight
- Clearance lights
- Whipping and swerving
- Proof of trailer ownership



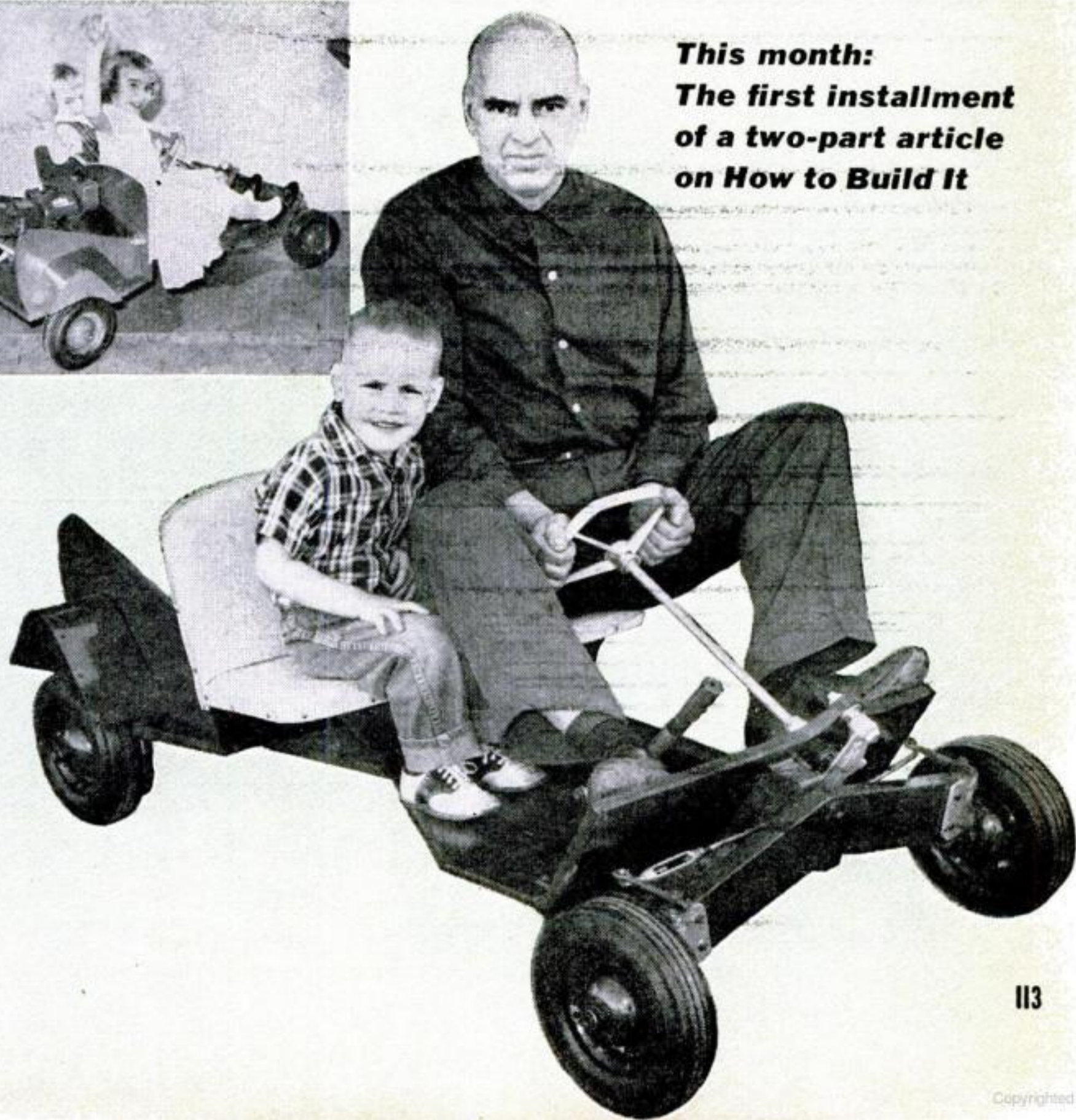


M  
and  
SECTION

**INTRODUCING...**  
**The Popular Science**  
**Kinderwagen**

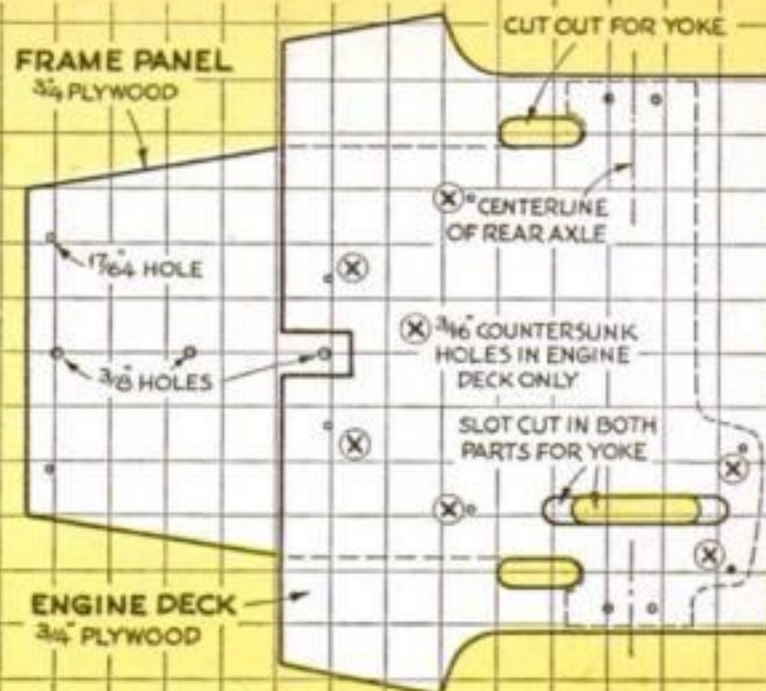
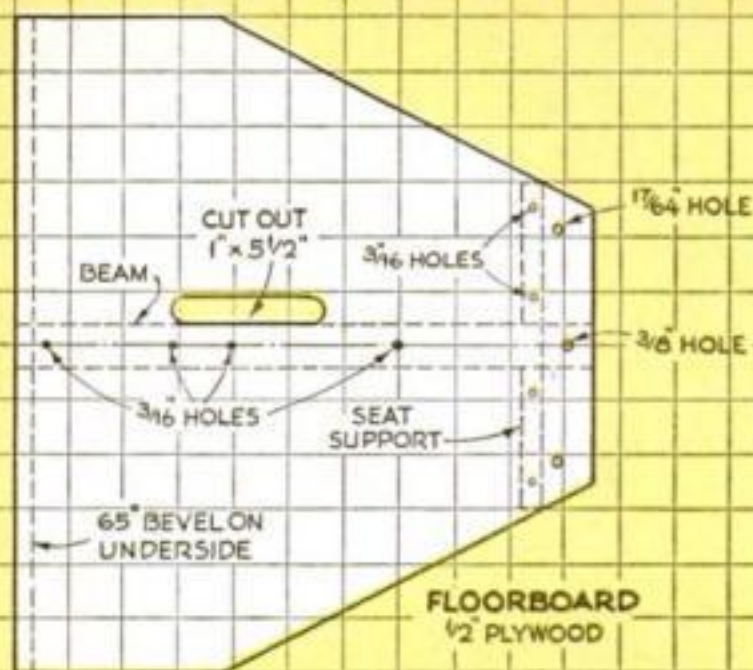


***This month:  
The first installment  
of a two-part article  
on How to Build It***

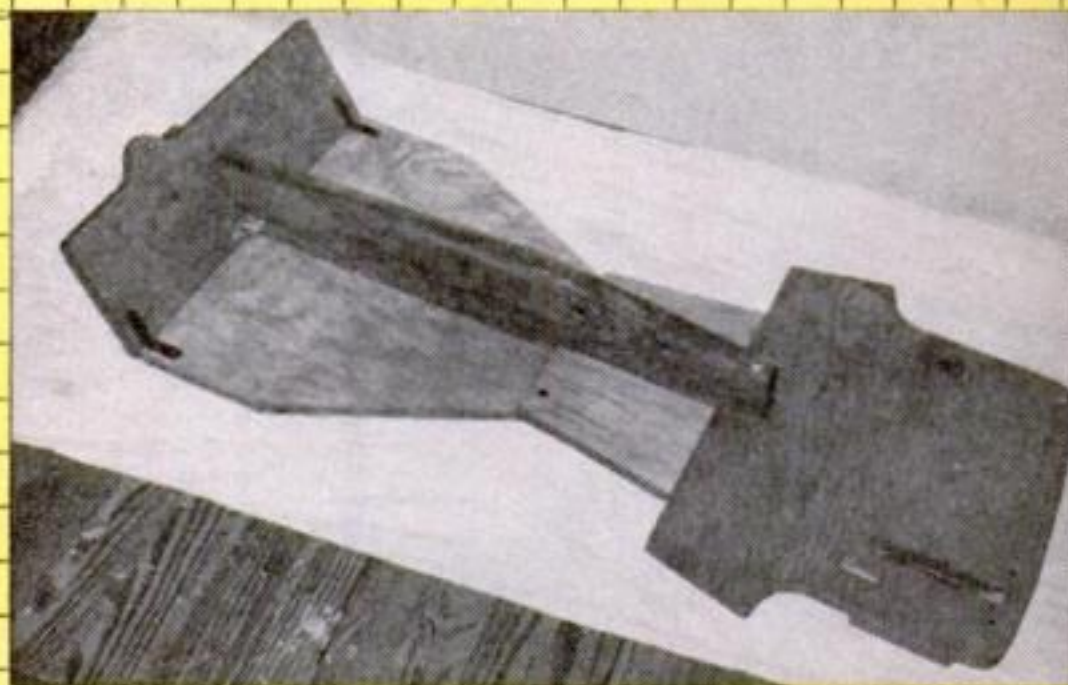
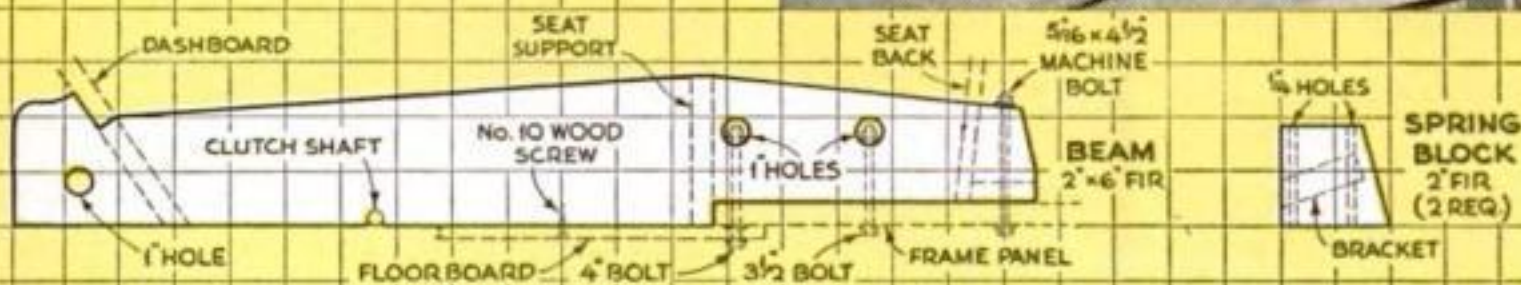
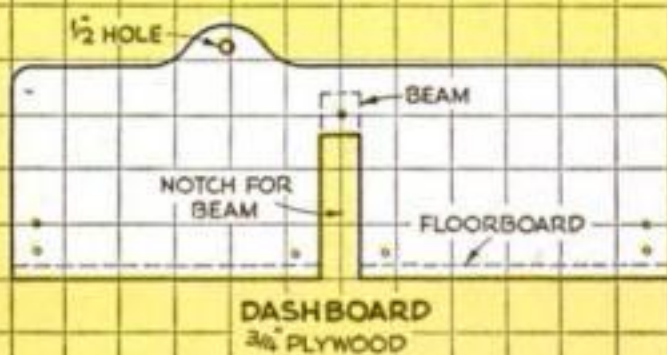
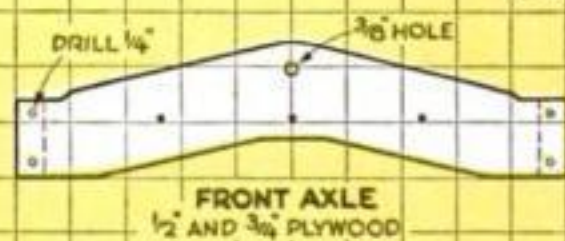
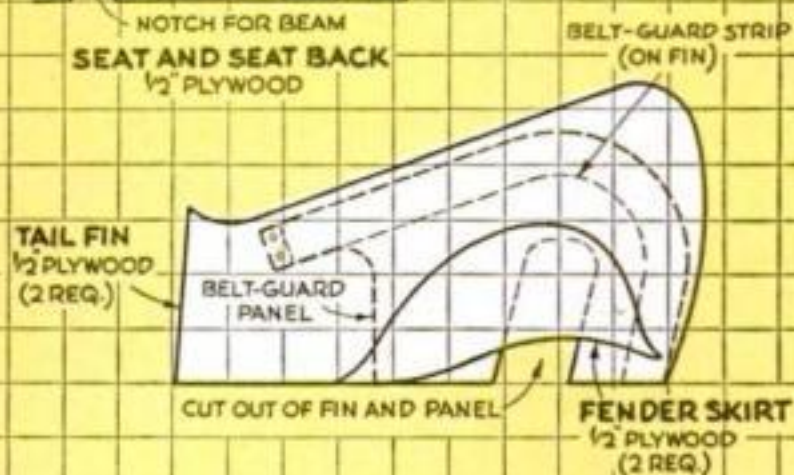
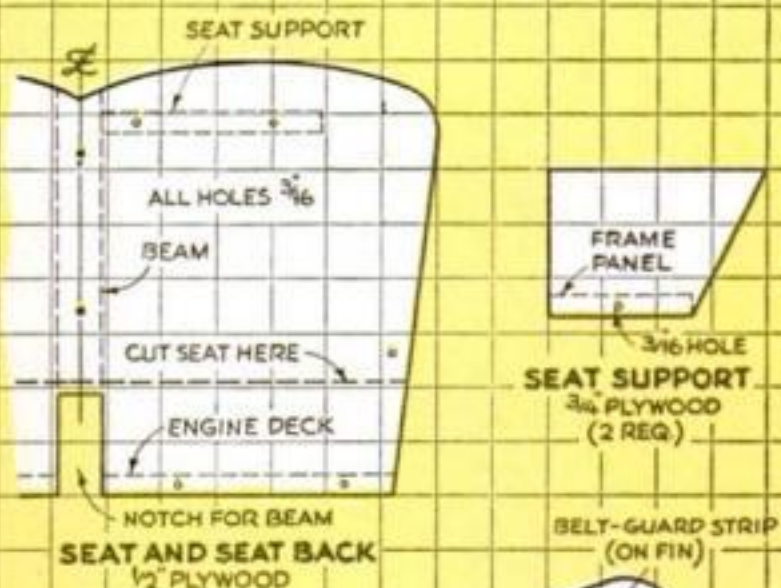




**Scale up these patterns for wooden frame members**



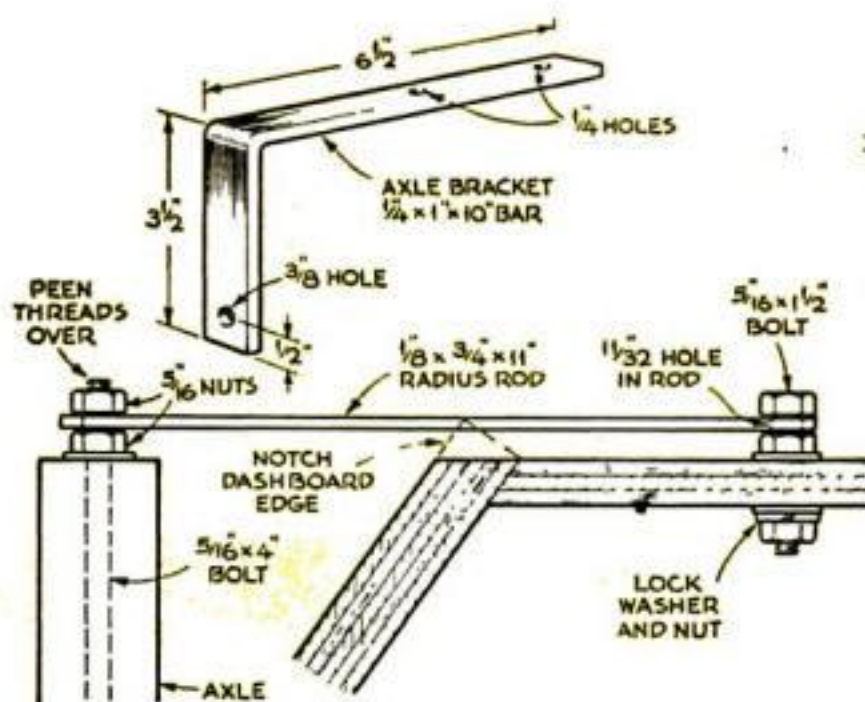
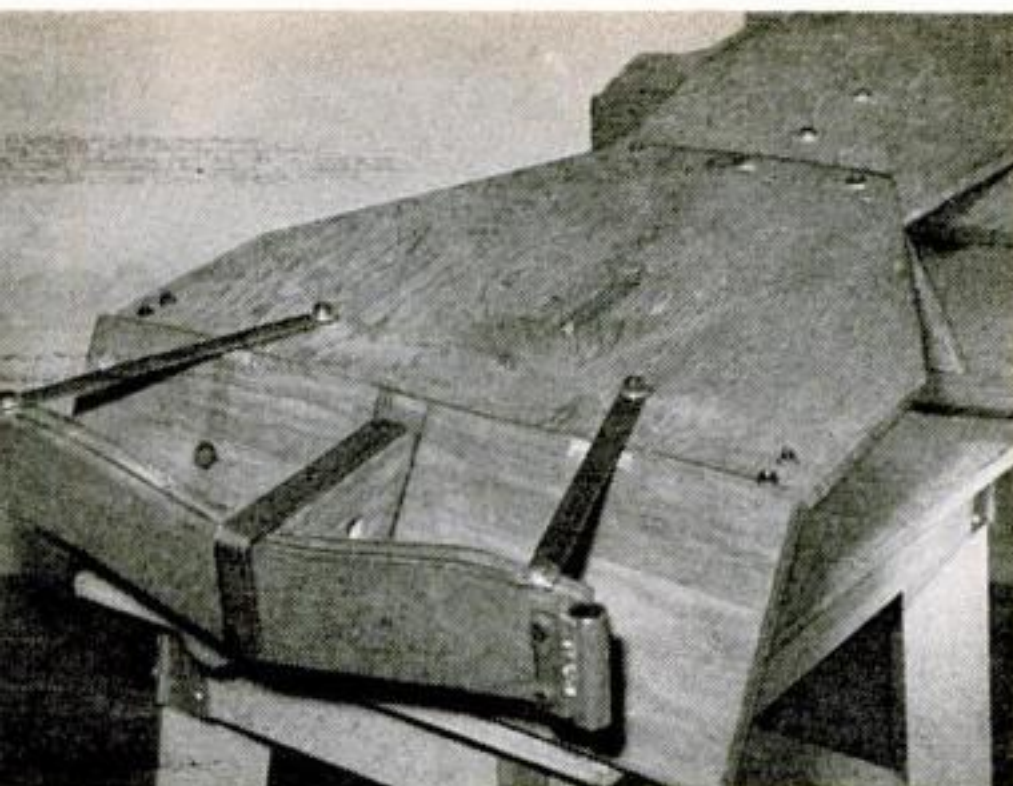
2" SQUARES



**JOIN FRAME PANEL** to the floorboard with two 1/4" carriage bolts, the beam to the frame panel with 5/16" machine bolts and to the floor with 1 1/4" wood screws. Mount the dashboard with metal straps at corners, stamped brackets to the beam. Fasten down engine deck with six wood screws. Square the back with the seat (below) before screwing it to the deck edge.



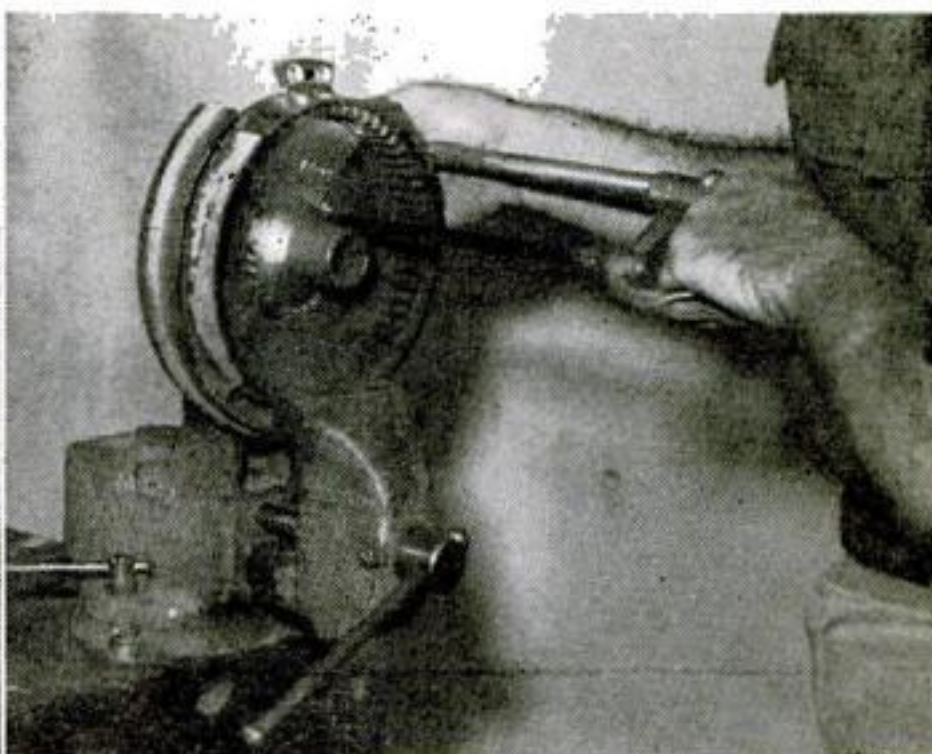




## Wooden axle is pivoted to iron out the bumps

**FRONT AXLE TILTS** on the centerline of the beam, letting wheels ride over bumps or into depressions without twisting the frame excessively. Axle pivots on the smooth shank of a lag screw. Before mounting the axle, drill a ver-

tical hole in it at each end, inside the knuckle bearings, for 5/16" bolts that secure the radius rods. Notch dashboard edge to give these vertical play. Hole visible in beam (left) is provided for a tie rod to pass through.



## Step-down steering gears come from an old mower

**HACKSAW THE HUB** and a sector of the internal gear from an old lawn-mower wheel. Drilling holes beforehand shortens the sawing job. Leave a section of the rim outside the gear for at-

taching the tie rods. If the wheel has no outer rim, weld on a lug. Saw the bearing stud off the sideplate, drill it out 1/2", and mount it as the sector bearing.

## Put your kids behind the wheel of a cart they can drive safely. Part one: making frame, body, and steering assembly

**By Lyle Gilliom**

**A**TOT can drive it, a man can ride on it, and any boy or girl will have a grand time with the POPULAR SCIENCE Kinderwagen (German for "children's car"). But this is no import; you can build it yourself—and enjoy doing it. And look at these features:

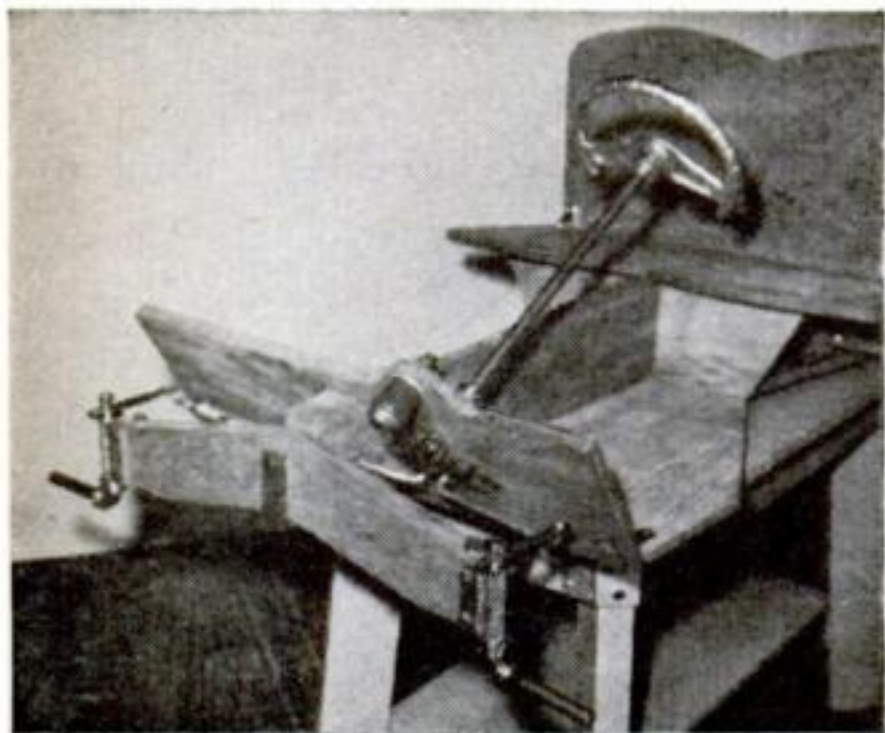
- Twin seats for twice the fun.

- Single-lever control.
- Power reverse for just-like-real backing, parking, maneuvering.
- Braking on both rear wheels.
- Smooth, geared-down steering.
- High-traction two-wheel drive.

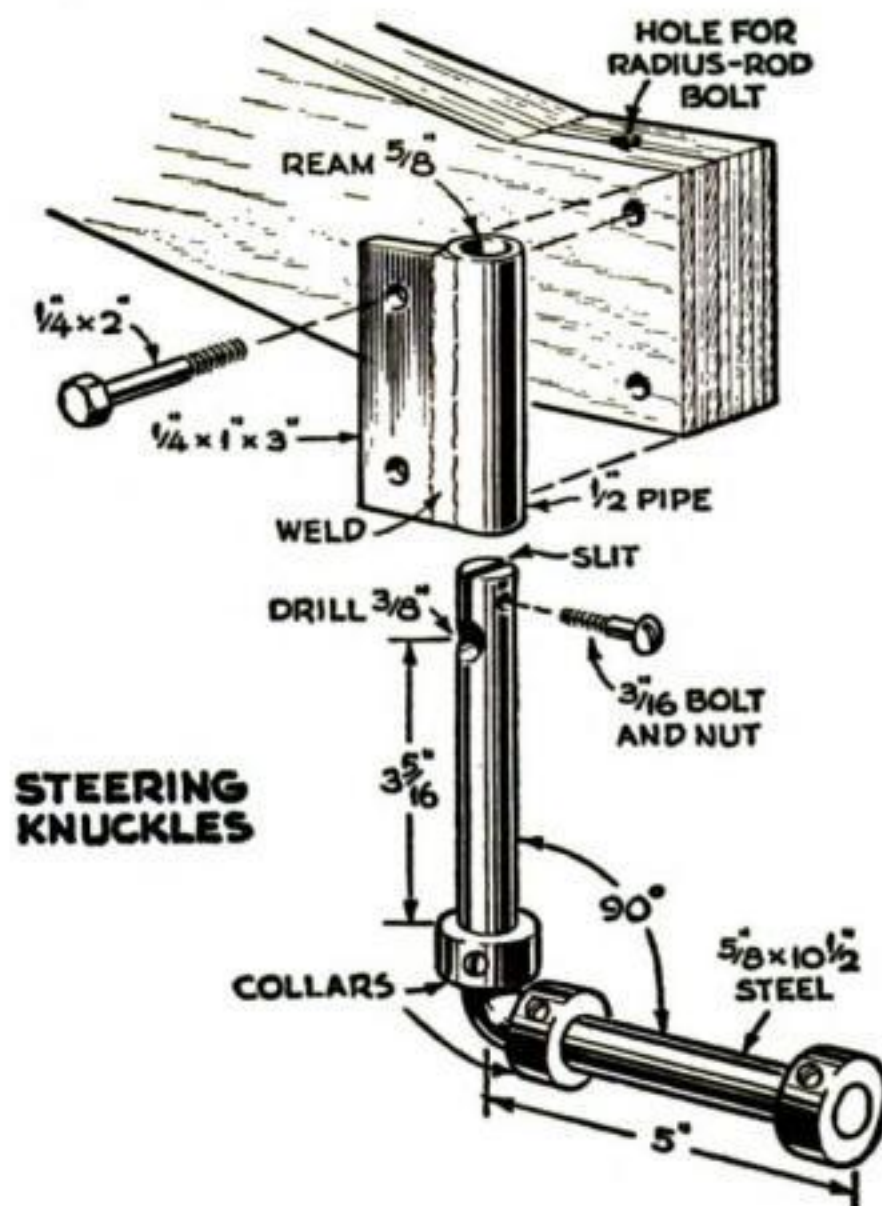
Not meant for racing, this is a safe, sensible motor cart that will give children hours of fun off the street. Its excellent steering and power reverse make it a de-



## How to make front-end linkage and a steering wheel



**STEERING KNUCKLES** are retained by the steering arms (with washers under them), each arm being clamped by a bolt and nut through the split end. Screw the steering-shaft bearing on inside the dashboard. As tie rods are subject to axle tilt, the holes in the gear sector and steering arms must be countersunk on both sides to prevent binding. The built-up steering wheel (shown at far right) has a laminated rim.



**STEERING KNUCKLES**

light to operate even in a back yard or driveway, and the two-wheel drive gives it ample go-power even over rough lawns.

Building it is no trick. The few welds necessary should cost no more than three or four dollars. Wheels, pulleys, and axles are widely available. An old reel-type mower, which provides parts for the steering gear, should be easy to find.

All details are shown here, but readers who want to save themselves the trouble of scaling up the squared patterns can buy full-size plans of these parts and all steering and drive details.

.....  
**NEXT MONTH:**

## How to Power the Kinderwagen

You'll be intrigued by the ingenious drive and control system. It's a dilly. No machining is necessary. Add any four-cycle, horizontal-shaft engine of 1½ hp. or more—and you're ready to roll.

**Frame and body.** Lay out the plywood parts on ¾" and ½" stock as specified. Where slots are shown, bore holes at the ends first; then saw between them. Note that the frame panel and engine deck partly coincide on the drawings, but are two pieces, joined with the deck on top.

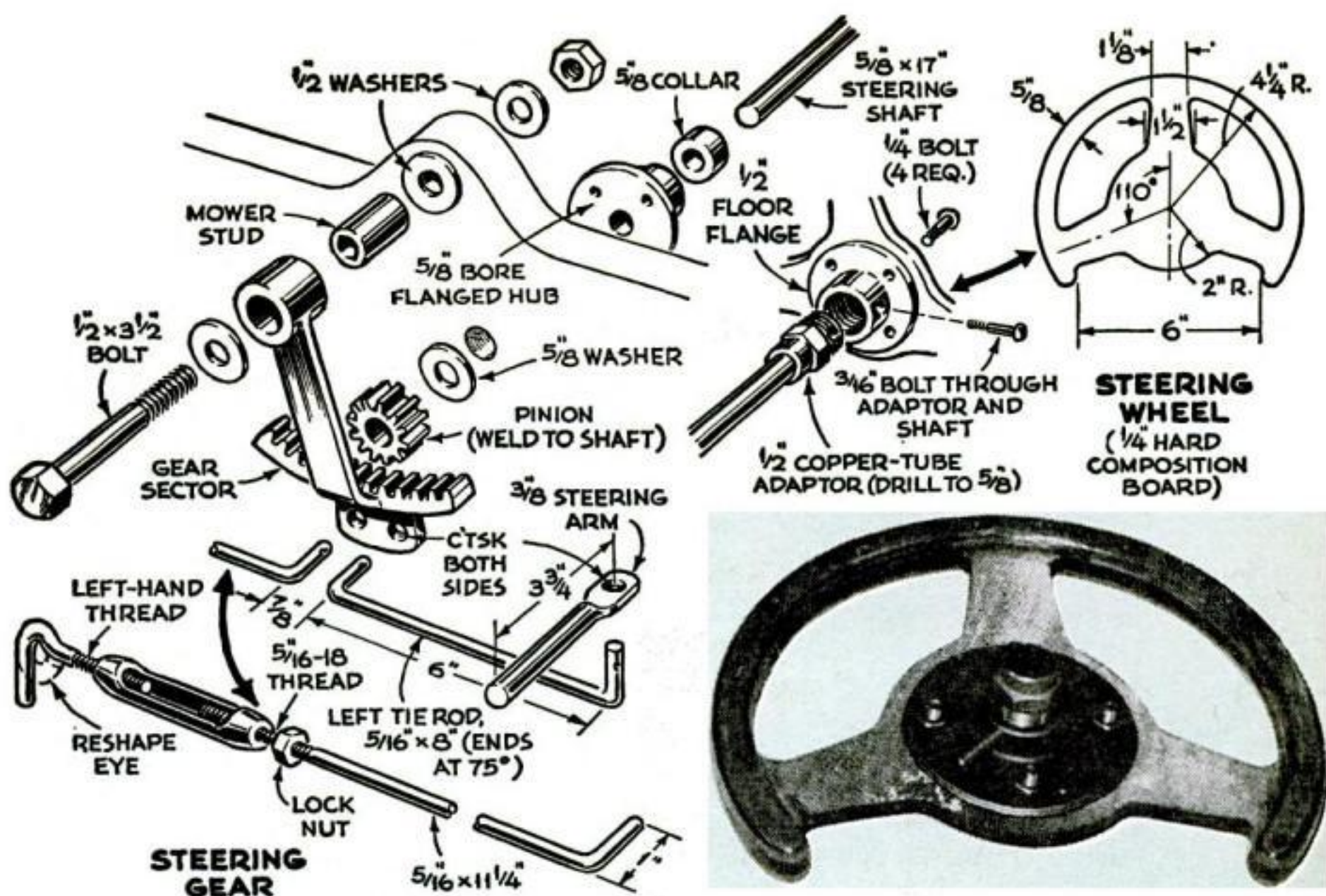
Begin assembly with the frame panel and floorboard. Then mount the girder or beam. Use washers under each bolt head, ordinary and lock washers under every nut. Countersink the wood screws holding the beam to the floorboard and the engine deck to the frame panel.

Fit the dashboard to the floorboard bevel with two angles, bent from strap iron and held to the dashboard with wood screws and to the floor with ⅜" stove bolts and nuts. Screw stamped corner brackets to the beam and dash.

Square the seat and its back (see photo) before screwing the seat to the beam and the back to the edge of the engine deck. Add corner brackets between seat and back, fastening them with ⅜"-by-1" flathead bolts.

Fit the seat supports between the seat and floorboard, with 1½"-10 screws into the front edge of the frame panel and





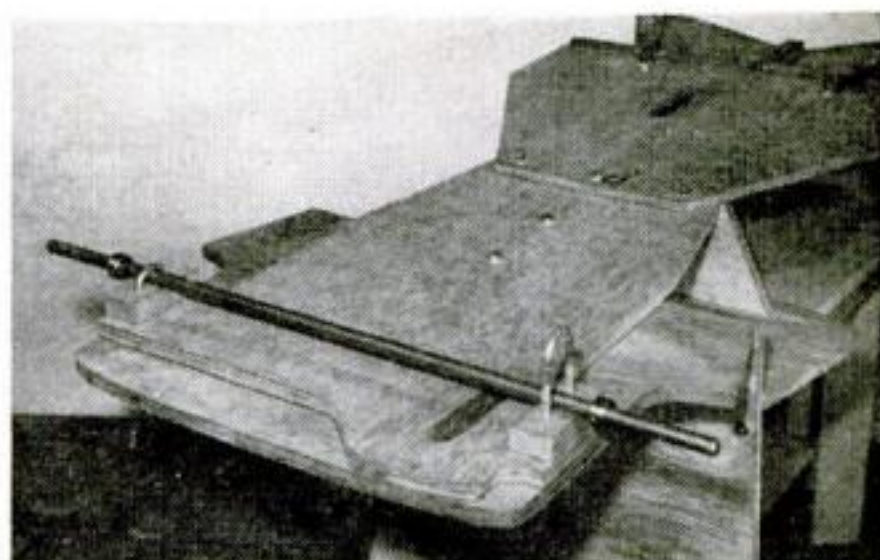
1 1/4" screws through the seat, well countersunk.

**Front axle.** Build this up by joining identical pieces of 1/2" and 3/4" plywood with waterproof glue and three flathead 1"-10 wood screws driven through the 1/2" stock. Clamp. Let set overnight.

Make steering-knuckle bearings of 1/2" pipe welded to a bar the same length (cut from the handle brackets of the old mower). Then turn a 5/8" reamer through the pipe. Mount the bearings on the axle with 1/4" machine bolts, lock washers, and nuts.

Bend the axle support also from the mower handle-bracket bar. Fasten it to the bottom beam edge with 1 1/4"-14 roundhead wood screws. Pivot the axle on a 3/8" lag screw running through the support bracket into the beam. Grease the hole in the plywood, and put a washer on each side.

Drill the flat radius rods 1 1/2" for a free fit on 5/16" machine bolts. Drill a vertical hole at each end of the wooden axle, insert a 5/16"-by-4" bolt, and tighten a nut against a washer underneath. Slip on a radius rod, turn a second nut on loosely, and hammer the threads over to retain it.



**CUT REAR AXLE** from 5/8" shafting to 30" length. Mount it under the frame panel with wood blocks between. File shallow grooves in the axle where the U bolts grip it, so that it will not be able to shift endwise.

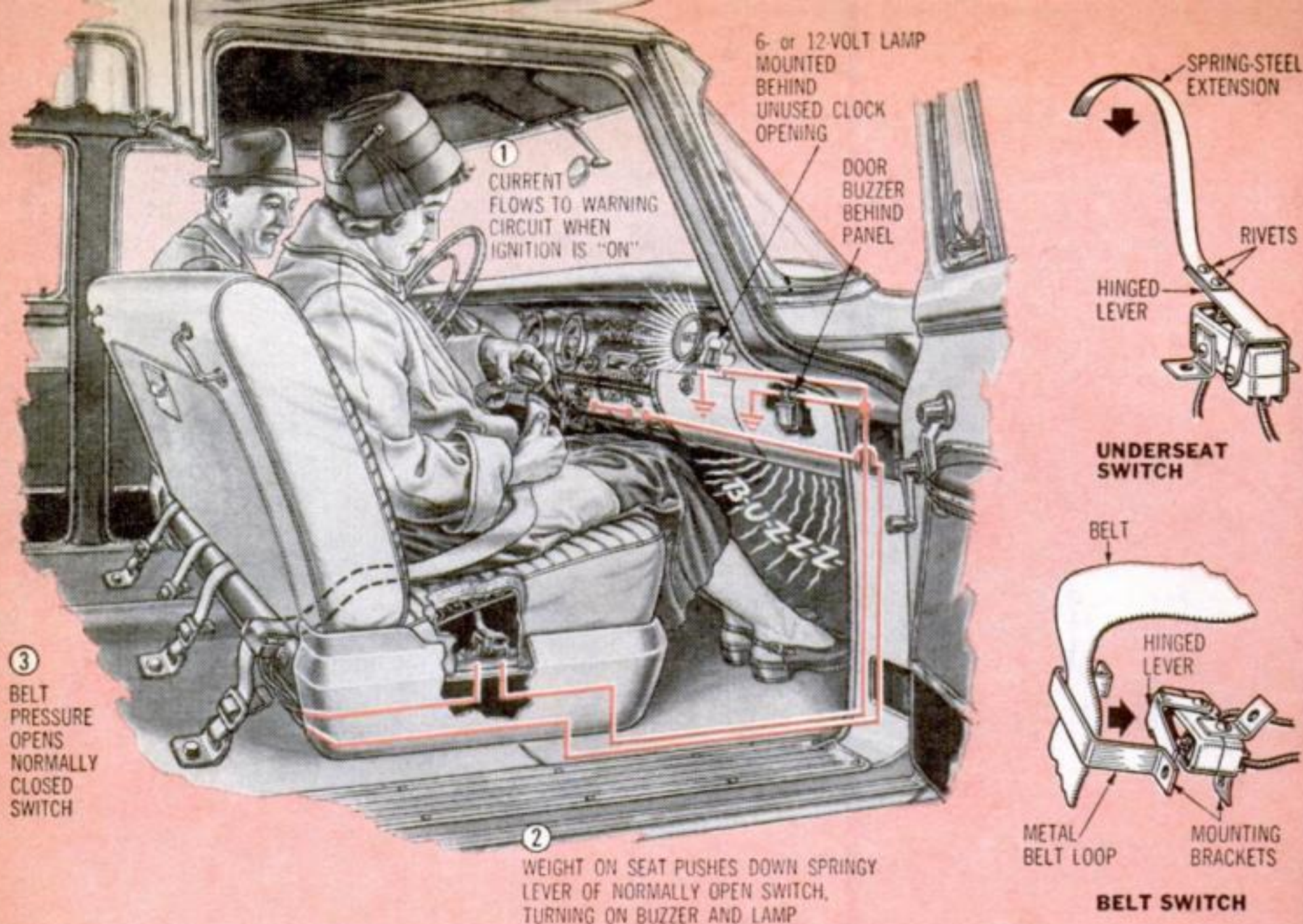
At the floorboard end, invert the 1" bolt—head under the rod—again spacing the nut for up-and-down movement.

**Finishing the body.** With the rear axle mounted (see photo), the body is ready for painting. Apply sealer and two coats of enamel. Paint tail fins and fenders separately. Paint metal parts aluminum.

**Steering gear.** The secret of good steering control for small fry is step-down gearing. It is made from a pinion and

[Continued on page 214]





## How I Got My Wife to Use a Seat Belt

FOR 10 years I have used safety belts in my car. But each time we went for a ride I have had to tell my wife to fasten her belt. She is a most stubborn person and uses all kinds of excuses for not doing so.

I have finally won. These drawings show how. The system tells her to put the belt on. It works like magic every time. It saves arguments. The little reminder consists of a light, the words "Safety Belt," a buzzer, and two cunningly wired snap switches.

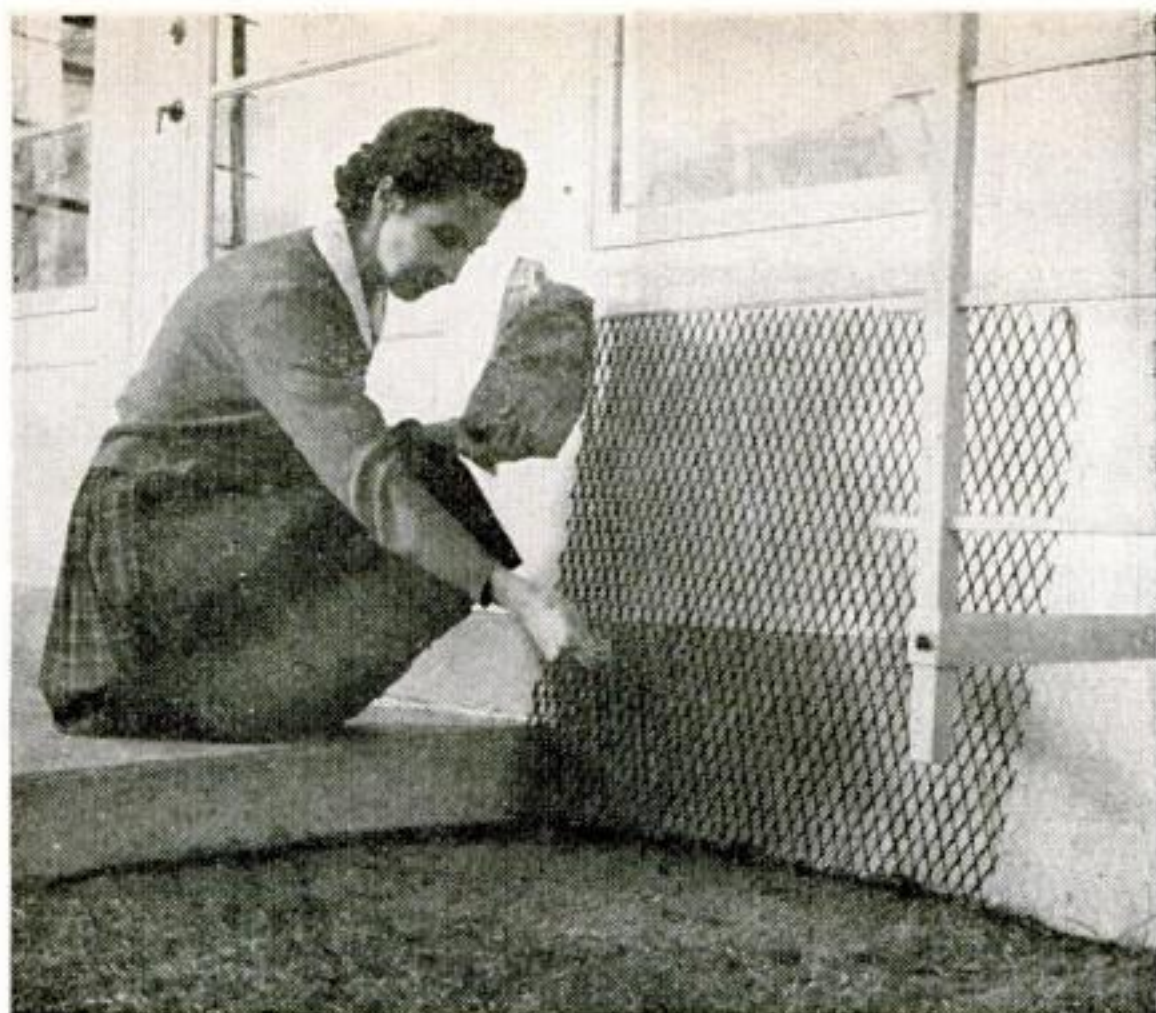
When my wife gets into the front seat beside me, her weight trips a normally open snap switch under the seat. Two things happen: First a doorbell buzzer begins sounding behind the dash, attracting my wife's attention toward it. Second, in the opening where a clock usually is mounted, the words "Safety Belt" are

illuminated by a lamp behind the dash.

The second snap switch, normally closed, is mounted under one strap of the belt so that it is opened by the pressure of pulling the belt across the waist. This breaks the circuit, stopping the buzzer and turning off the lamp. As long as my wife sits in the seat, she'd better have the belt on correctly or the buzzer will let her know. [Editor's note: An optional cut-out switch is shown in the drawing for those who might like one.]

Now, when we start out, she races me to fasten the belt before I can use the ignition key and turn on the circuit. Seems she doesn't like to hear the buzz. The only way to stop the buzz is to get out of the seat or turn off the ignition—or put on the belt. If she wants to go for a ride that leaves her little choice.—*Wes Jayne, Woodhaven, N.Y.*





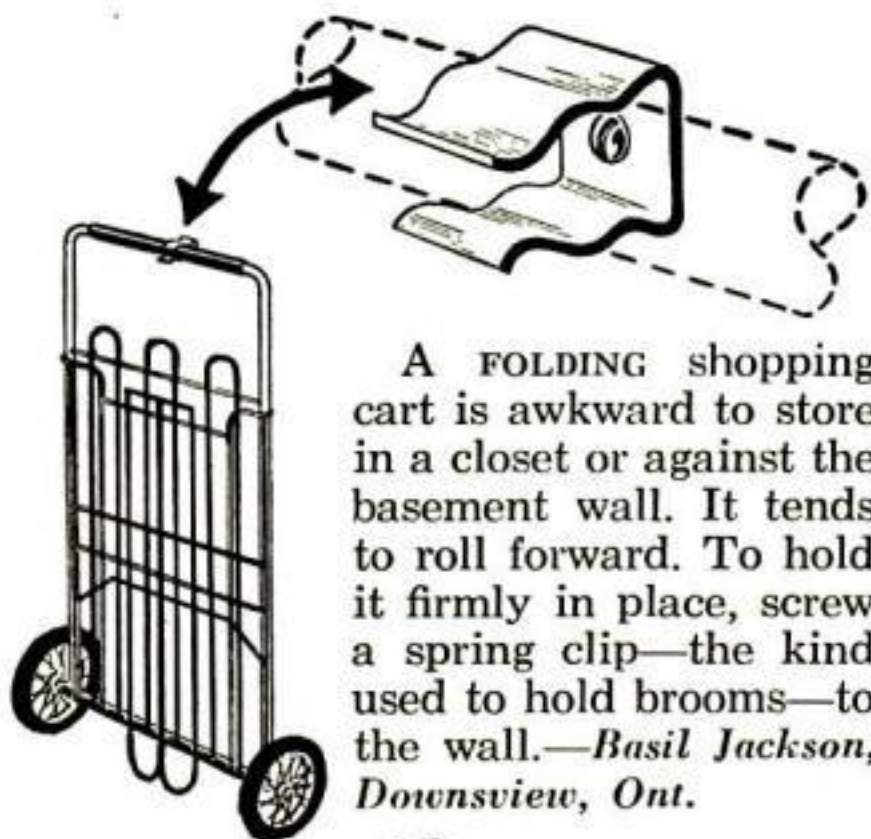
## Short Cuts and Tips

FROM PS READERS

### Grille Protects Seeded Area

TO PROTECT a freshly seeded lawn patch from scratching fowl, digging animals, and careless strollers, try the idea shown at left. Lay a piece of expanded metal over the area. Once the seed sprouts, it will grow through the metal. When the new grass is an inch high, remove the grille. —E. W. Kraft, Chicago.

### Stowing a Shopping Buggy



A FOLDING shopping cart is awkward to store in a closet or against the basement wall. It tends to roll forward. To hold it firmly in place, screw a spring clip—the kind used to hold brooms—to the wall. —Basil Jackson, Downsview, Ont.

### How to Bale Old Newspapers



WIRE coat hangers can be used to bale old newspapers. Square the hanger as shown, slide in as many papers as you can, then twist the wire tight. The hook is a convenient carrying handle. —Stephen N. Stresnic, Fort Lauderdale, Fla.



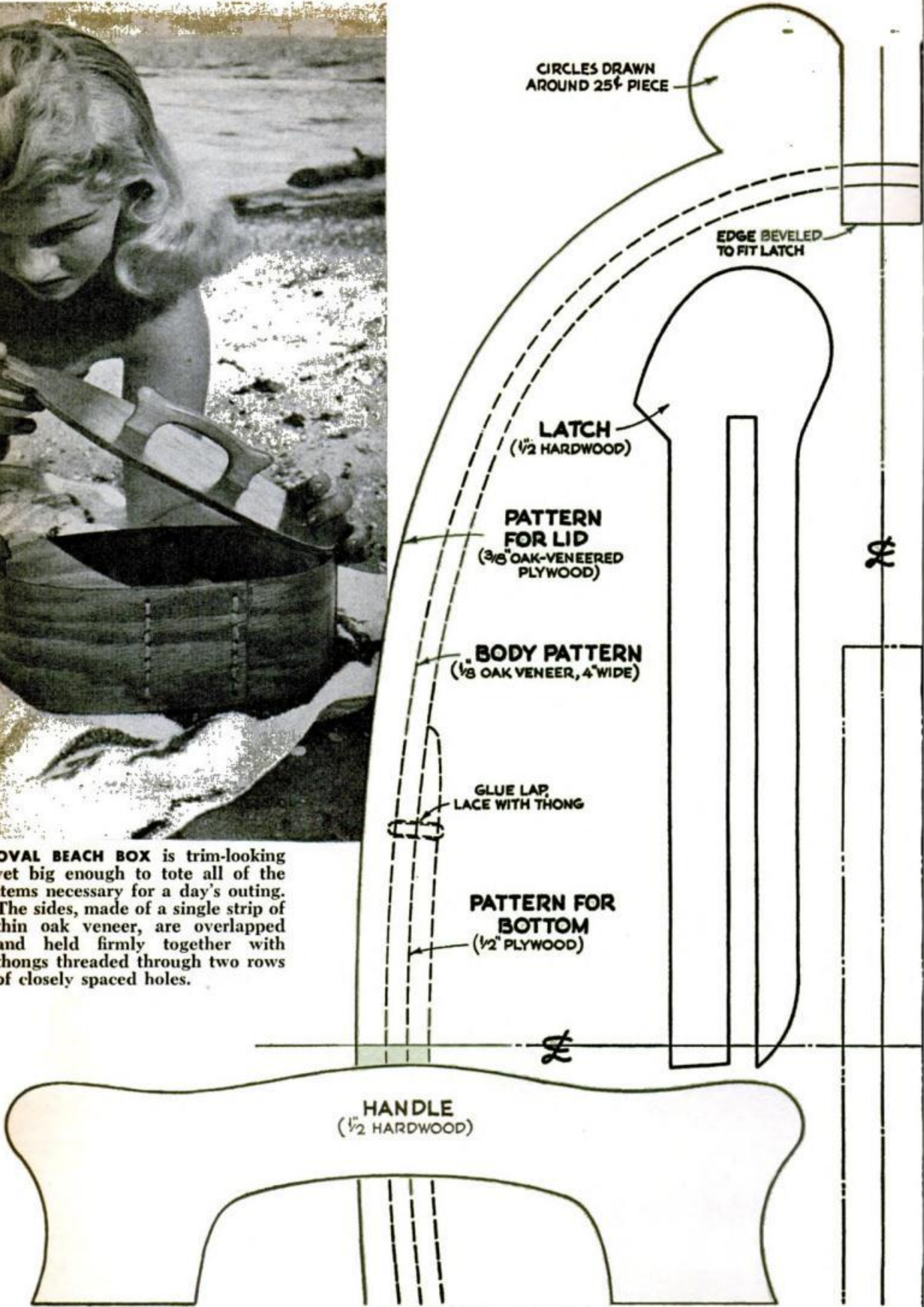
### Dodge for Reading Old Blueprints

A SMALL red neon advertising sign, if you can get one, is even better for bringing out the details of an old, faded blueprint than the engineer's trick of reading through a sheet of red cellophane. Plug in the sign, and hold it from 18" to 24" above the surface on which the blueprint is mounted, as illustrated in the sketch at left. —W. C. Wilhite, Carlinville, Ill.





**OVAL BEACH BOX** is trim-looking yet big enough to tote all of the items necessary for a day's outing. The sides, made of a single strip of thin oak veneer, are overlapped and held firmly together with thongs threaded through two rows of closely spaced holes.





# Latch-Lid Beach Carryall

is shaped  
from springy  
oak veneer

WHATEVER it is that girls carry to the beach will fit handsomely into this trick latch-lid toter. The latch lid, an old Scandinavian device, is held on by a wood catch at each end. Pull back on either catch with your thumb and off pops the top.

The body is springy oak veneer about  $\frac{1}{8}$ " thick and 4" wide, glued and tacked around an oval bottom of  $\frac{1}{2}$ " plywood. Steam or soak the veneer until it's pliable. At left is a full-scale quarter pattern of the lid and bottom. By repeating the pattern, you can make a full-size plan.

The handle and latch pieces are shown full-size complete. Glue a latch to each end, slipping it over the veneer. Bevel the slots in the lid to match the bevels on the latches. Give the box two coats of spar varnish.—*John Burroughs, Tacoma, Wash.*

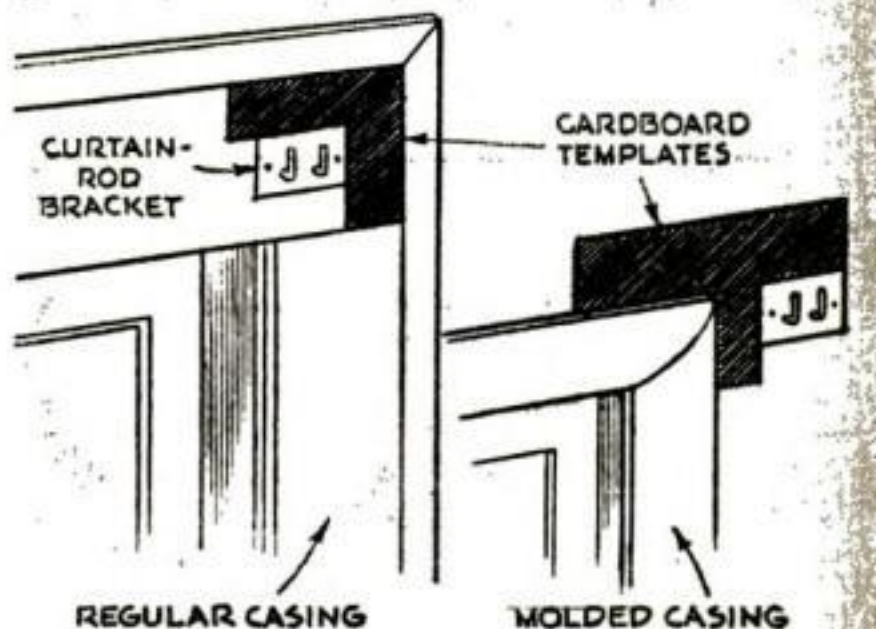


UNLATCHED FROM EITHER END, the lid is free to slip completely off for full access to the carryall's contents. Replacing it is a simple matter of snapping it back on.



## Guiding the Garden Hose

TO KEEP a garden hose from dragging across flower beds or snarling around small shrubs when you pull it to another location, stake out its route with croquet wickets. U-shaped lengths of coat-hanger wire will also do the job.—*Mrs. Edwin Johnson, Iron River, Mich.*



## Template Locates Rod Brackets

WHEN installing a number of curtain-rod brackets, you can determine uniform locations quickly by using a template cut from stiff cardboard. It may be L-shaped to position brackets inside the corners of flat casings, or T-shaped for locating them on the wall next to molded types.—*Victor H. Lamoy, Upper Jay, N. Y.*

## Let That Car Sealer Stretch

WHEN you store a new car in a hot garage during the summer, leave car doors on half latch. Summer heat often causes weather-seal material to acquire a set. Leaving the doors open slightly lets the rubber regain its shape.—*Ken Martin, Milwaukee.*





For metal-joining jobs you sometimes  
can't do otherwise:

# Try Fry-Pan Soldering

*RECIPE: Add a dash of flux, garnish with bits of 50-50 alloy, and place in a steel frying pan on a burner turned to high heat. Remove from fire as soon as alloy fuses.*

By Walter E. Burton

**A**RE those words in italics above the recipe of a famous chef? Not at all. Just an easy bit of soldering you can do in shop or kitchen when your soldering iron or torch proves too puny or tedious, or isn't working right.

Fry-pan soldering is simple. You heat the work pieces in a skillet over an electric or gas burner until the solder melts and forms the joint, or many joints. Among the jobs it makes easy:

- Joining numerous small parts quickly without disturbing any of them—as you probably would if you tried to do it with an iron.

- Soldering joints in a complicated assembly without necessarily wiring or clamping parts together.

- Soldering things that must be heated uniformly to prevent distortion.

- Soft-soldering large chunks of metal together, or a small piece to a large one.

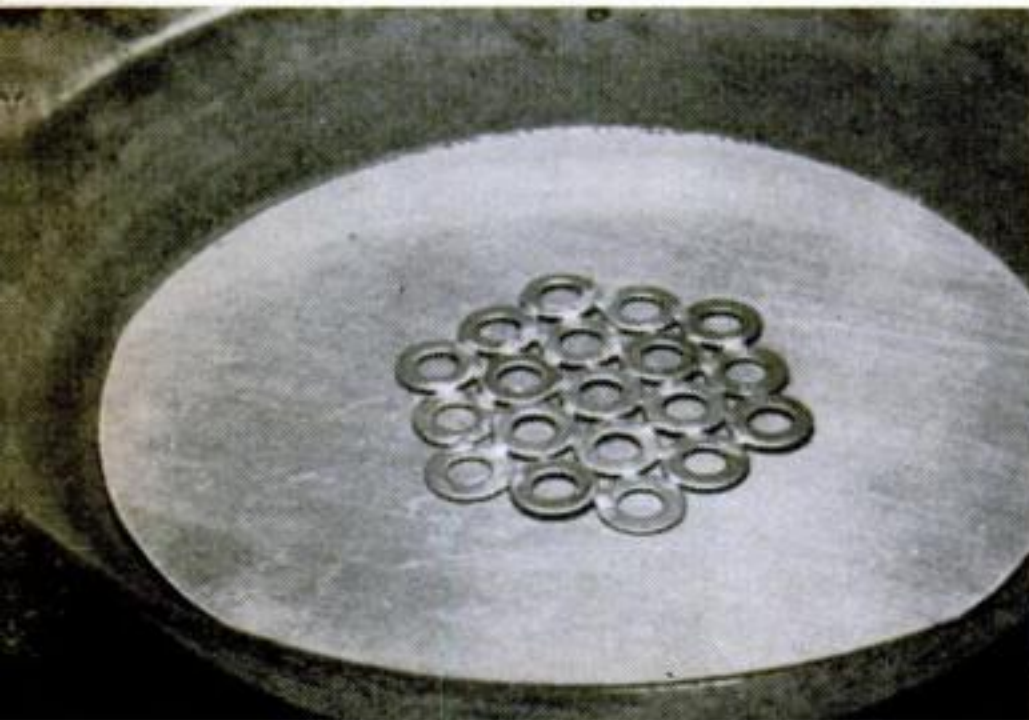
**DECORATIVE GRILLE** was made by heating 19 steel washers on an aluminum insert in frying pan. The 42 joints were formed simultaneously in about two minutes with a soft-solder paste.

- Making neat soldered joints of considerable extent, as around the bottom of a tray or box.

For soft soldering, an aluminum frying pan will do, but be careful not to melt it. For hard-soldering with silver or an easy-melting alloy, use either an ordinary sheet-steel or a stainless-steel type. (Cast-iron might do, but soaks up a lot of heat, and could fracture.) Use a sheet of stainless steel as an insert to keep solder from sticking to an ordinary steel frying pan. An aluminum insert will do if only soft soldering is what's cooking. After each use, clean off scorched flux and polish the insert with abrasive cloth.

Solders you can use include ordinary 50-50 (half tin, half lead) and other soft types, perhaps cut into bits for easy application; paste-type solders (not self-drying "plastic solders"); and silver

**DOZEN JOINTS** for this model wheel were formed at one heat in a 15-cent toy frying pan. When a joint lacks solder, more paste can be added easily with a stick, as you see here.







**COOKING WITH SOLDER:** Chef's hat and mustache at right are just a gag, but there's no fooling about frying pan and hotplate. In job shown, ring and disk were cleaned bright, heated; then wire solder was fed along joint, above.

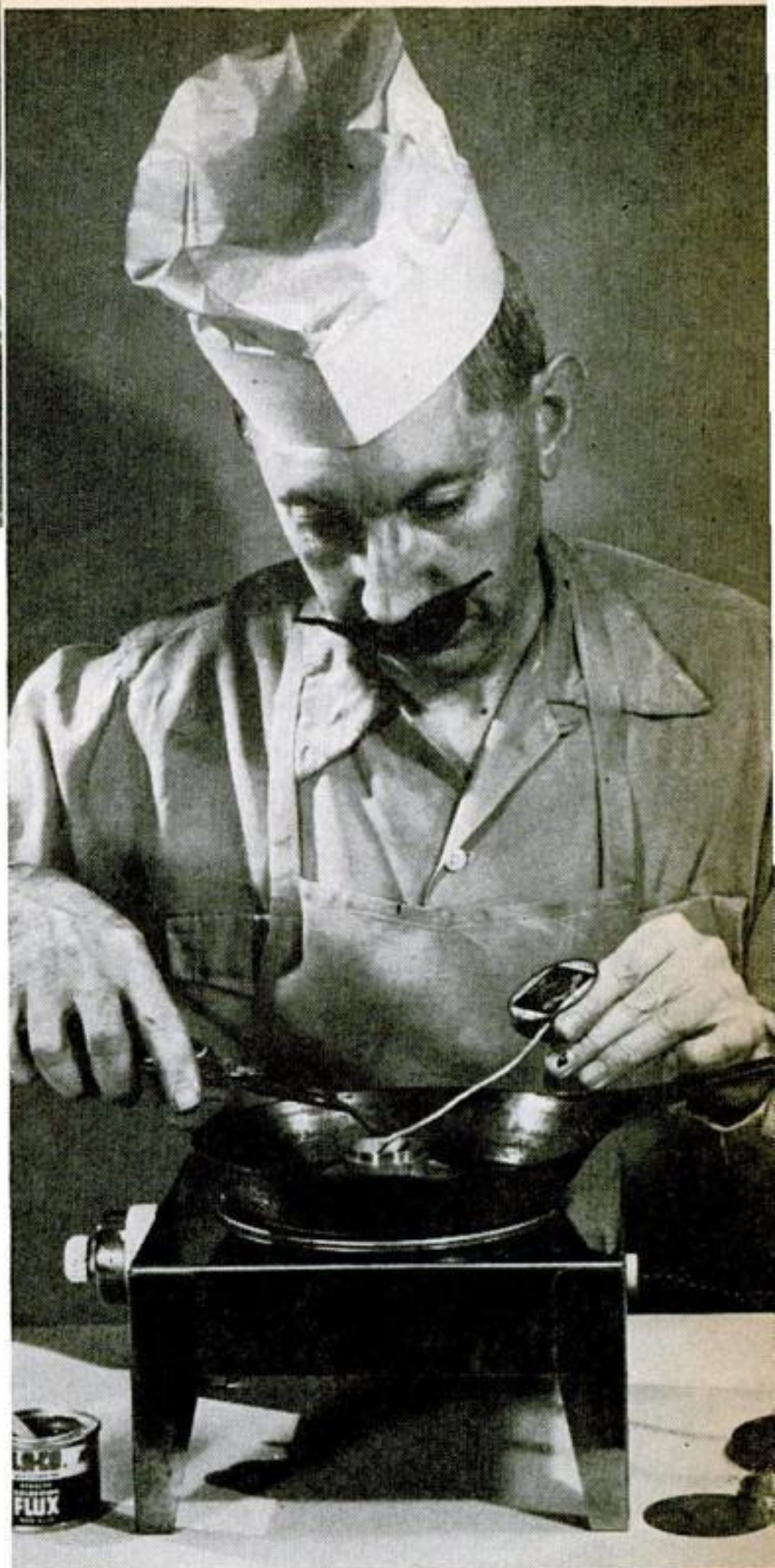
solder and hard-soldering alloys having easy-flowing characteristics. Of course, the proper flux is required. Paste types already contain it.

You'll have to decide on the best time to apply the solder, though you usually can spread flux on joint surfaces before starting the heat. Sometimes it is better to heat the separated parts in the frying pan, tin the joint areas, and sweat together.

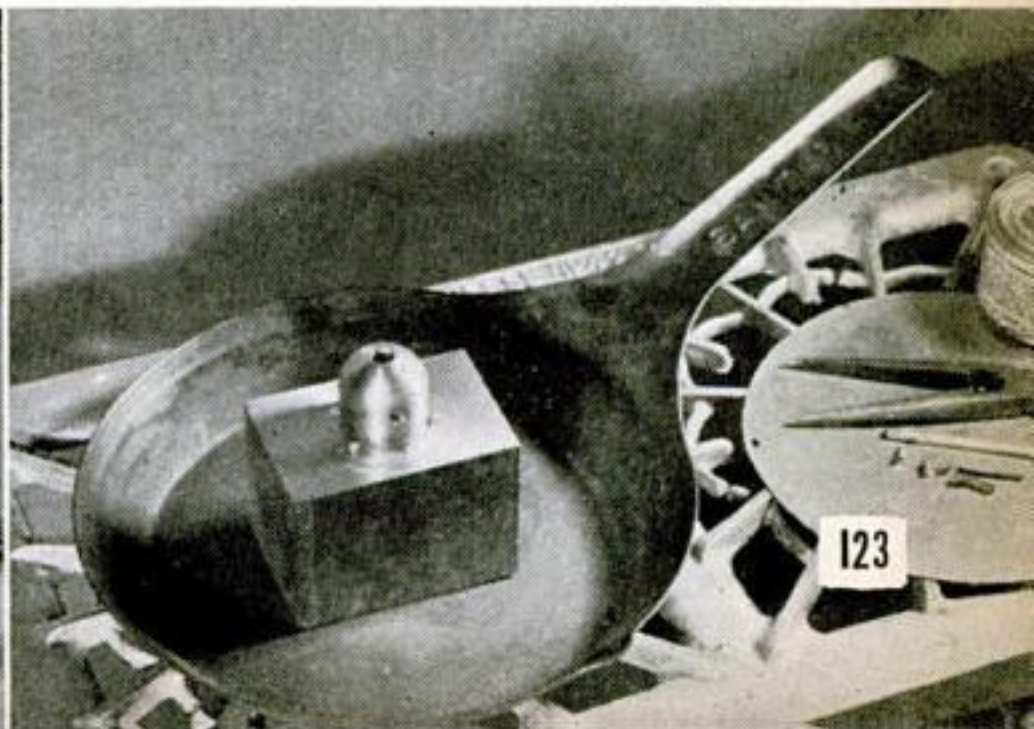
At other times, you can add pieces of solder while the work is cold, placing them so they will be drawn into the joint when melted. Still another way is to add flux only, heat, then touch wire solder to the joint. Paste-type solder is handy when many joints are involved. Don't cook the job any longer or at a higher heat than necessary. For one thing, scorched flux can be difficult to remove.

You'll sometimes get smoke and fumes. So work in a ventilated area.

**A COVER**, such as a tin can, keeps cooling air away from the work, permits faster, more even heating—especially for high-temperature soldering. Silver-soldering alloy was used here.



**PRE-TINNING** the surfaces to be joined is desirable in jobs such as the one shown below—soldering a rod-holding stud to a large steel block to make a base for a shop magnifier.



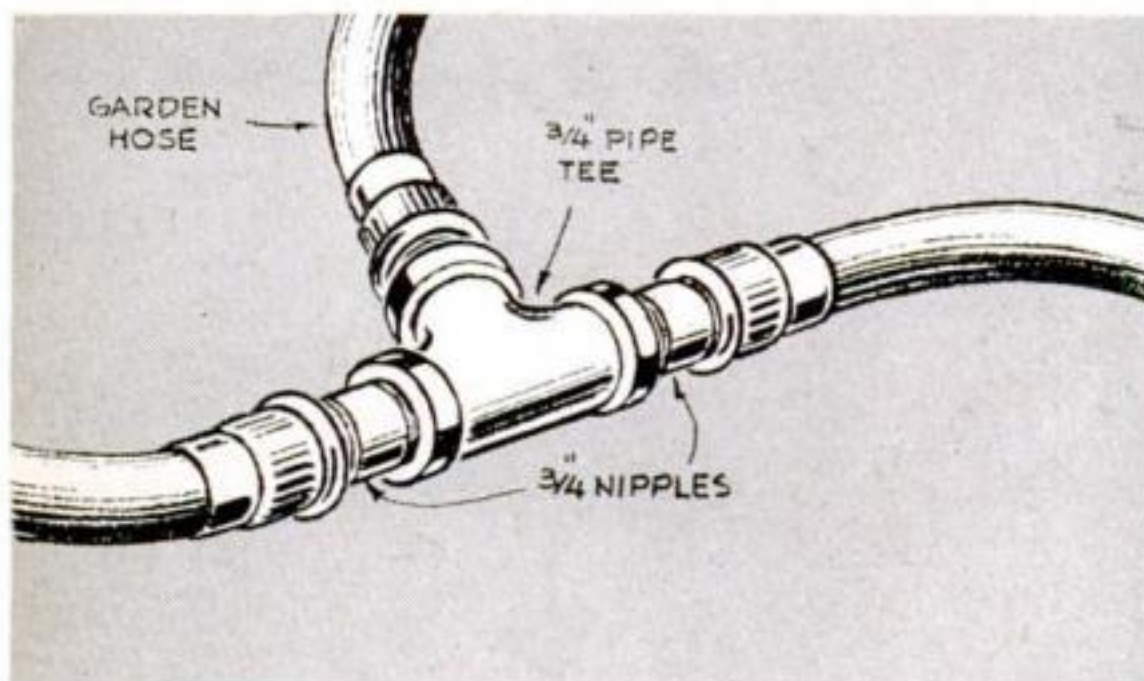
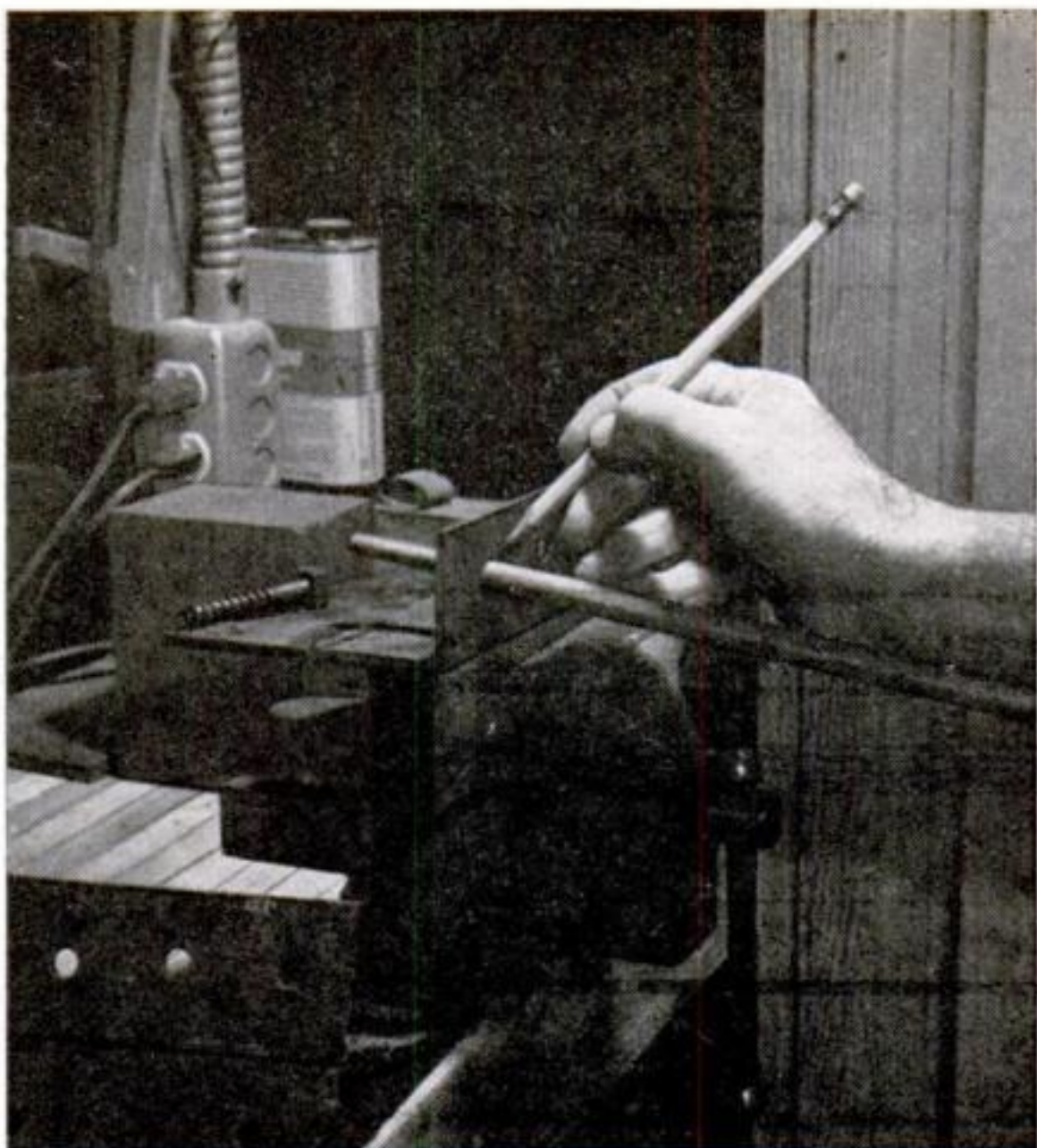


## Short Cuts and Tips

FROM PS READERS

### How I File Holes to Identical Size

LACKING a drill of the correct diameter to make a series of exact-size holes for lag screws through a metal plate, I underdrilled and enlarged each hole with a tapered rat-tail file. After using the cut-and-try method to get a perfect fit on the first hole, I inserted the file to its limit and marked the position with a soft lead pencil. Then I filed the other holes until this guide mark reached the face of the metal plate.—*Erik Miller, Sherman Oaks, Calif.*



### Pipe Tee for a Hose Branch

WANT to connect two lawn sprinklers to one garden hose? If you don't have a standard Y connector, try a  $\frac{3}{4}$ " pipe tee. Turn close nipples into the two end outlets for hose attachments for the sprinklers. The male end of the feed hose screws into the third opening of the pipe tee.—*Vance Lawrence, Buffalo, N. Y.*

.....WHAT'S YOUR ELECTRICAL IQ?.....

### The Case of the Apprehensive Apprentice

RED-FACED and uneasy, young Scofield approached the machine-shop foreman.

"I goofed," he confessed. "You warned me to shut that lathe motor off before reversing it. I forgot and shoved the switch back too soon."

The foreman looked stern. "And it kept right on running forward?"

The young apprentice nodded. "Yeah, even with the switch in reverse. So I shut it off before I wreck it worse."

"That's an expensive split-phase capacitor motor," the foreman pointed out. "But you can go back to work. Just take it easy with that switch and you'll find the motor runs fine in either direction." Do you know why? If not, turn to page 190.



**How you can join in an exciting quest  
for restorable examples of—**

# **The World's First Sports Car**



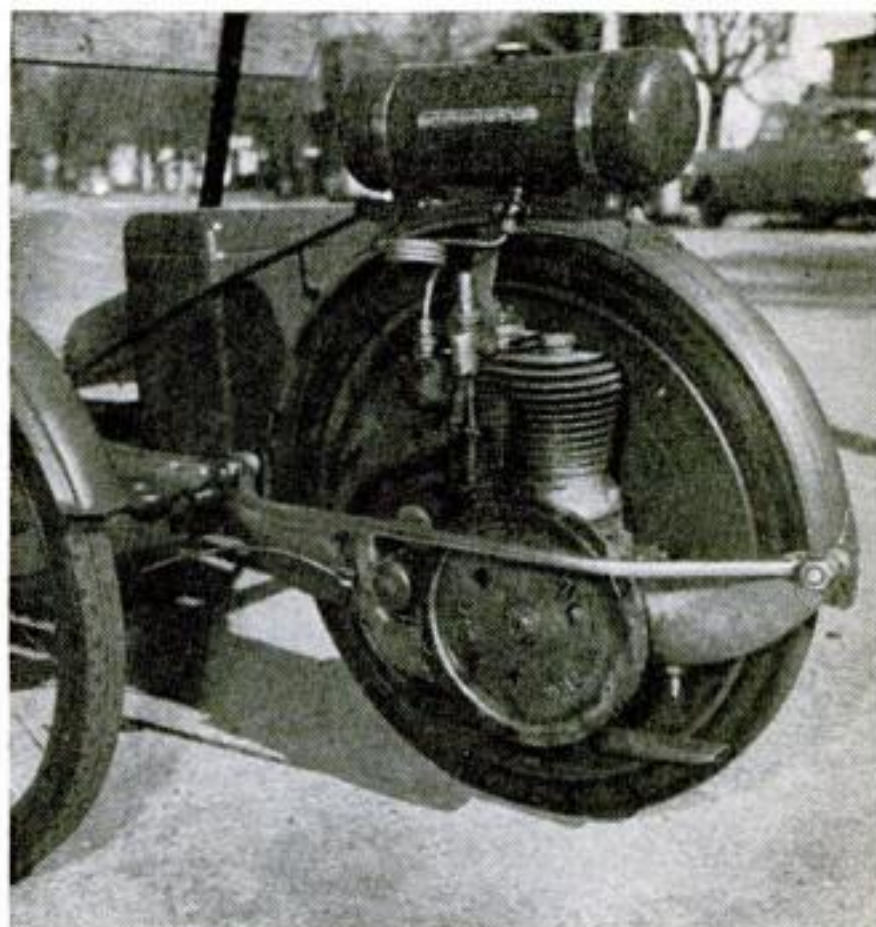
**By Robert Gorman**

**O**NE of the brightest prizes among antique cars is a classy little two-seater that you may have seen without even realizing what you were looking at. It has a body made of hardwood slats that, from a distance, you might easily mistake for a kid's coaster wagon. It isn't much bigger, either. But it has twin bucket seats, a breezy, open-air design, and has often been called the world's first sports car.

Its proper name is the Flyer, made first by A. O. Smith as early as 1917, then later by Briggs & Stratton. There aren't many around, but there are enough to make a search for them exciting.

Besides its buckboard body, the Flyer is distinguished by having five wheels on the ground. The fifth wheel supplies the power. Mounted in the rear, it carries its own one-cylinder engine bolted directly to it. A "shift" lever up front lets you raise the motorized wheel clear off the road so you can idle without stopping the engine. To start, you lower the wheel back onto the road. That's your clutch. To stop, you stomp on a pedal that presses

**TANKING UP:** Robert J. Baier, a Milltown, N. J., engineer, adds fuel to the "fifth wheel" that drives his 1917 Smith Flyer. Tank holds only half a gallon, but car will go 45 miles on it.



**DRIVE WHEEL** combines one-lung air-cooled engine and gas tank in a single unit that trails the buckboard. To stop, you pull a lever that raises the pivoted wheel off the road, stomp on pedal that applies fender brakes.

CONTINUED



**It may look like this  
—or something like it**

**FAITHFULLY PRESERVED**, this Flyer is about as close to the original as you'll find. Headlights, not stock equipment, have been added in many forms, as have other concessions to comfort like the backrests here.

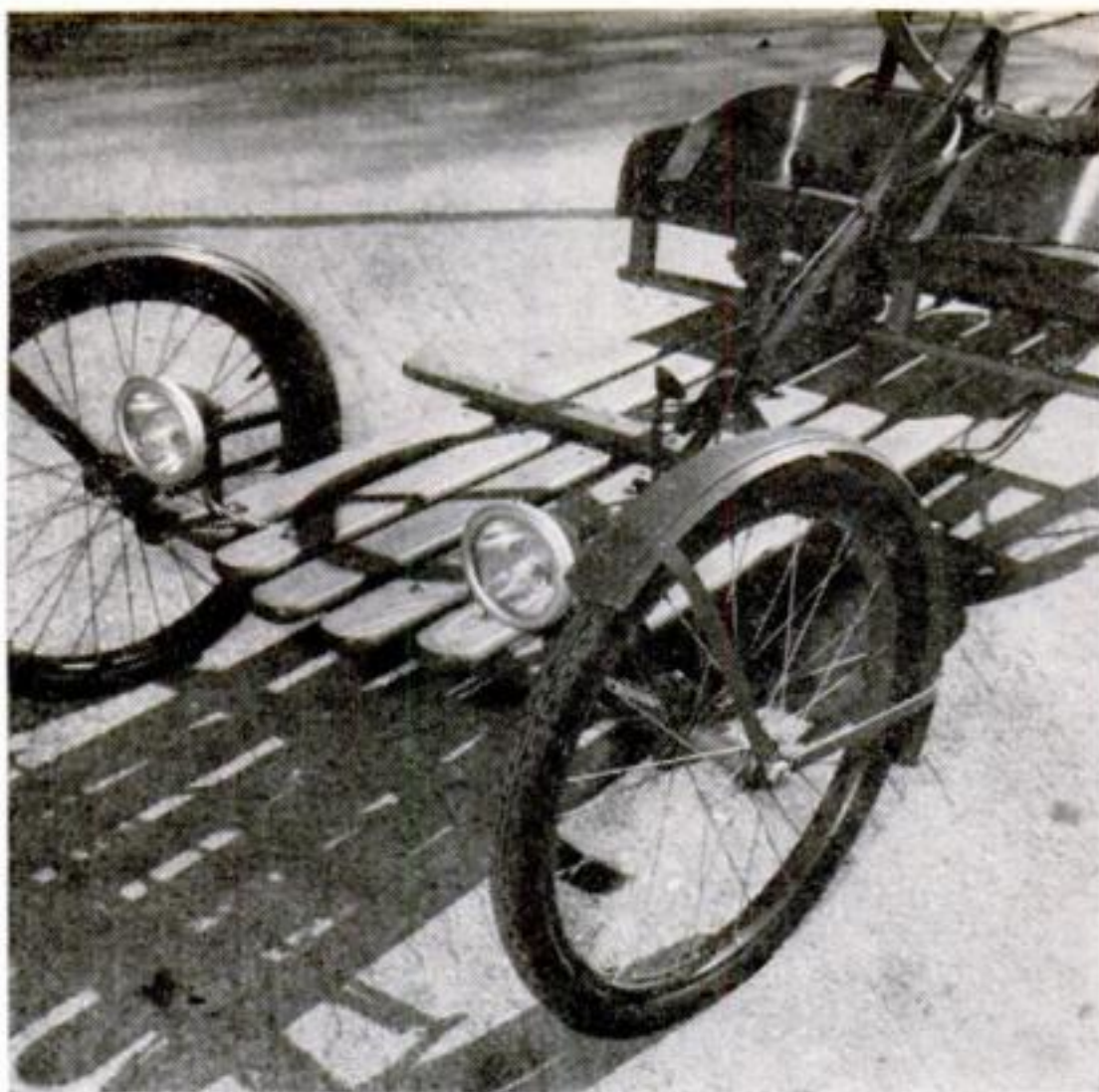
a pair of brake-lined fenders against the rear wheels.

**How to spot one.** While the fifth wheel is a dead giveaway, you can't count on it in trying to identify Flyers. Many have become separated from their power wheels over the years. In fact, of those that still exist, nearly half are hybrids—a body made by one manufacturer wearing a power wheel made by another.

That means that you are quite likely to find a body with no power wheel, or a wheel with no body. Without its fifth wheel, the Flyer looks even more like a kid's coaster. It even steers like one, its entire front axle pivoting on a single bolt.

Other vital Flyer statistics include a tread of 30" and a wheelbase of 62". With the drive wheel, the Flyer measures 92" and weighs 135 pounds.

In nearly a year of searching, I've been able to locate only seven fully or partly restored models. There are probably not many more restored ones that are not known to the antique-car experts.



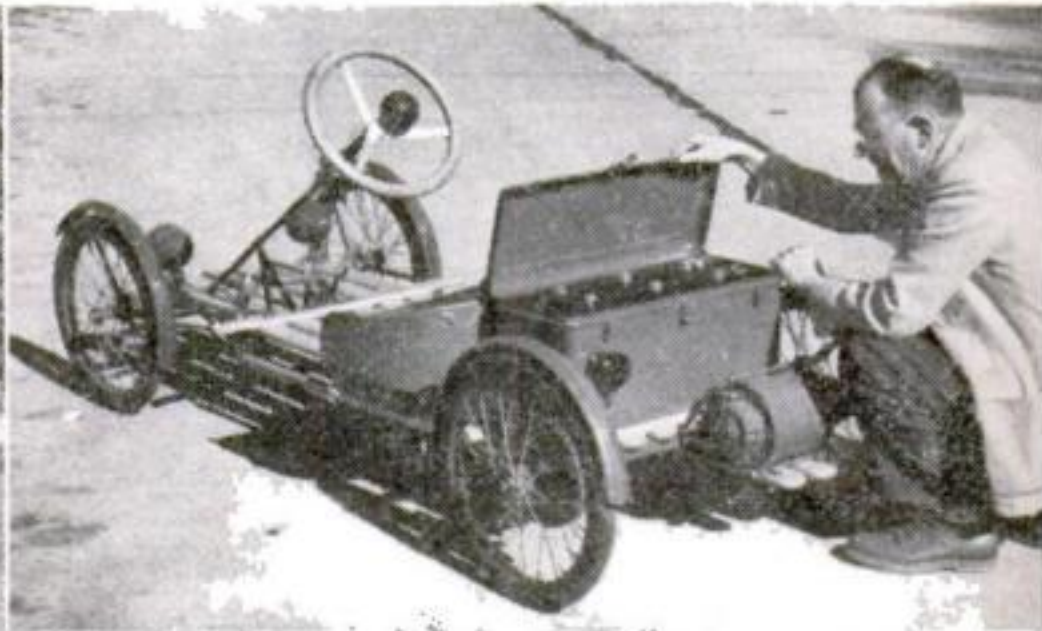
**Where are they now?** There's a problem that makes the Flyer both a fascinating and difficult piece of detective work. Because of its small size, you may find parts of long-forgotten Flyers hidden in places where you wouldn't normally go car-hunting—in cellars, attics, barns, sheds, even closets. The thrill of finding even a small part of one may spur you on to recreating this remarkable runabout.

If you spot a wheel with an engine on it that looks as if it belongs to a motorized bike, you may have hit pay dirt. The Flyer's drive wheel was originally designed as an auxiliary power attach-

**From the first to the last, the Flyer was a rare bird**



**FORERUNNER OF THE FLYER** was this gas-driven wheel designed as a power unit for bicycles. Many were sold in this form before the Flyer was introduced, so some should still exist.



**LAST OF THE FLYERS** was this electric-powered version, made up until 1925. Shorn of its distinctive fifth wheel and renamed the Red Bug, it was widely used in amusement-park rides.





**EARLY MAGAZINE ADS**, like the one reproduced above, picture the Flyer as a happy plaything for the young set, while Father takes to the more stately—and no doubt duller—family car.

ment for bicycles, and many were sold for this purpose before the Flyer was born. That means there should be a number of extra wheels in existence, waiting to be discovered. I found many unrestored models and pieces of models, indicating that the parts are there for anyone who's willing to look for them.

*A hundred miles to the gallon.* Although the rakish lines and ingenious rear-engine drive make the Flyer pretty sporty by modern standards, it was originally intended as an economy car for "Young America." Smith's earliest engines developed  $1\frac{1}{2}$  hp. from a piston stroke of  $2\frac{1}{4}$ " in a  $2\frac{3}{8}$ " bore. When Briggs & Stratton took over production in 1919, they increased the bore and stroke to  $2\frac{1}{2}$ " each. In one jump, this raised engine output by a third—to two horsepower.

Yet, in spite of its simplicity and modest power, the Flyer was no toy. It was a sturdy, road-worthy car. It could—and still can—zip along at speeds up to 25 m.p.h. Most important, it can get 80 to 100 miles on a gallon of gas. One owner in New Jersey, whose Flyer has been in his family since his father bought it in the early Twenties, used the car as reliable transportation all during the gas-rationing days of World War II.

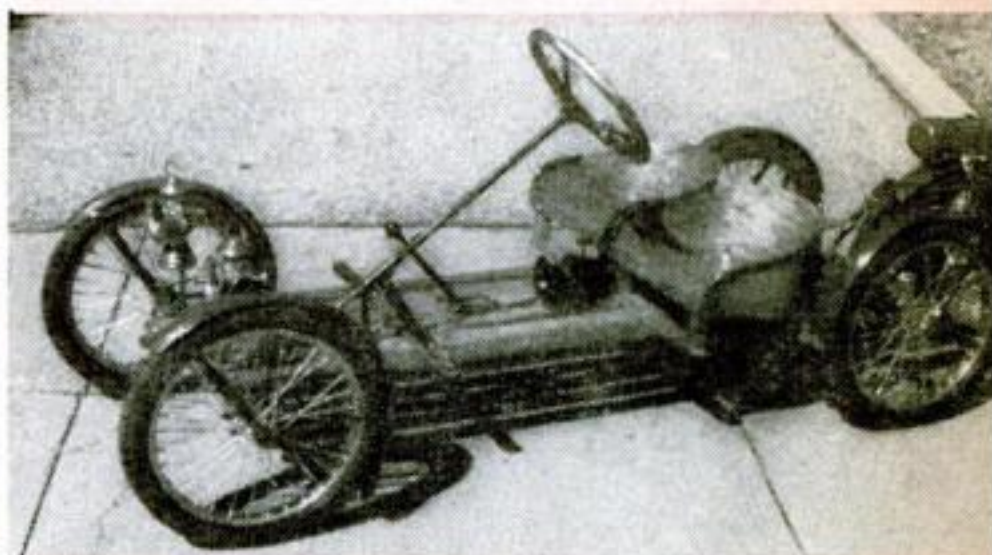
As some of the original parts are no longer obtainable, restorers have had to use ingenuity in finding substitutes. The New Jersey owner who ran his Flyer during the war has a fan blade taken from an old refrigerator. It runs in a roller-skate bearing. The old clincher-rim tires have

[\[Continued on page 222\]](#)

## These are four of the small number of authentic restorations



**ONE OF THE MOST ACCURATE** belonged until recently to the James Melton antique-car museum. It appears to be a hybrid, with Smith body, Briggs & Stratton engine.

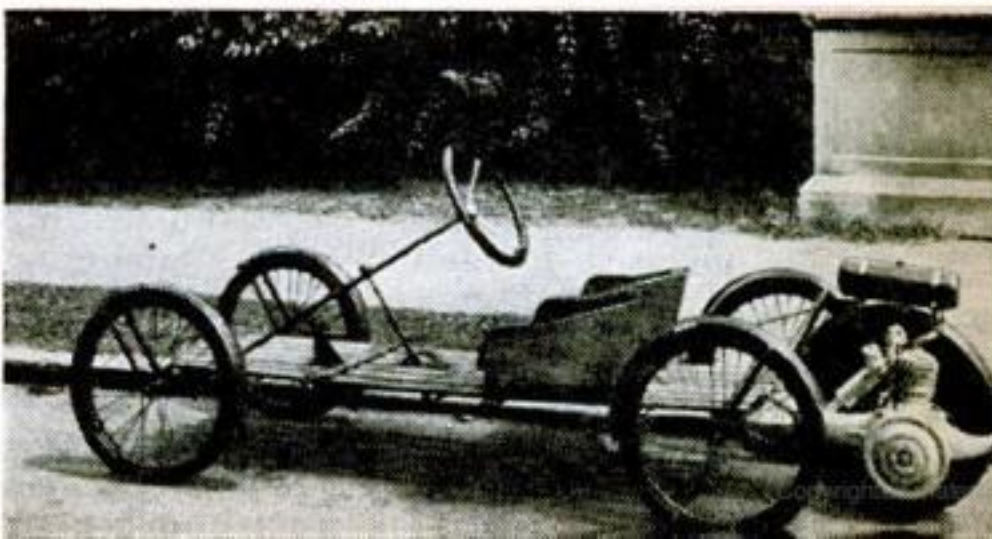


**ANOTHER HYBRID**, here a Briggs & Stratton body with a Smith engine, is owned by Kenneth Neal of Jacksonburg, Ohio, who bought it from the late John Baum.



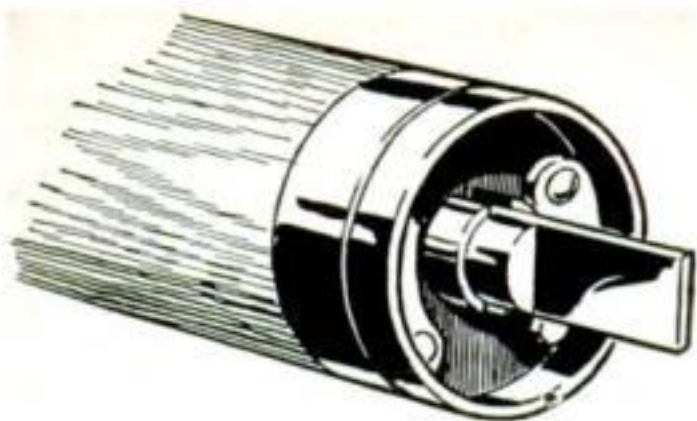
**SOLID FENDERS** show up on this version owned by Mayor Howard K. Stokes of Allenhurst, N. J. Its gas economy came in handy during World War II rationing.

**ONLY ONE MODEL** was kept by Briggs & Stratton, one of the two original makers of the Flyer. This lone remainder belongs personally to F. P. Stratton.

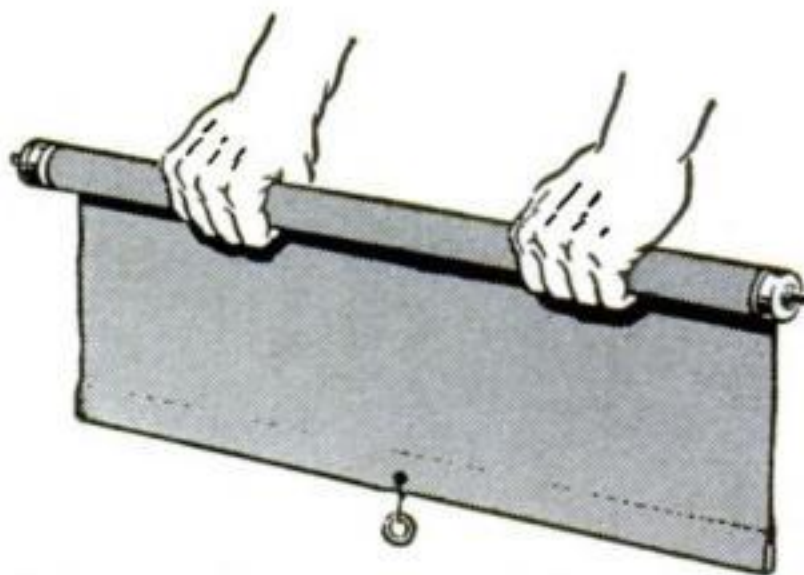




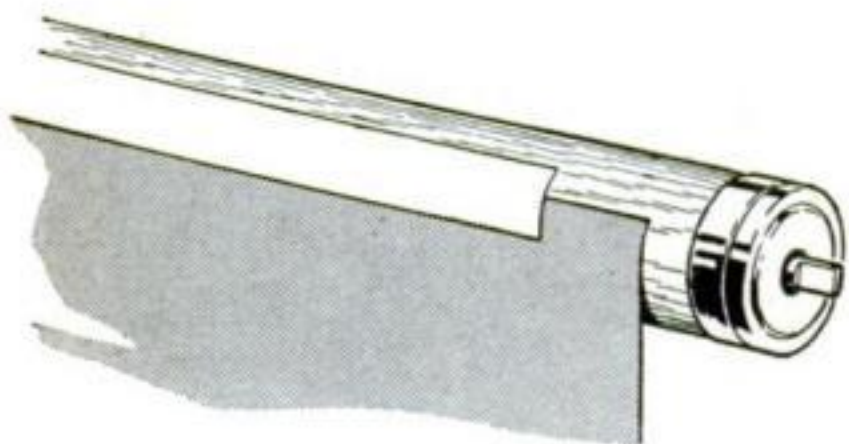
# Window Shade Know-How



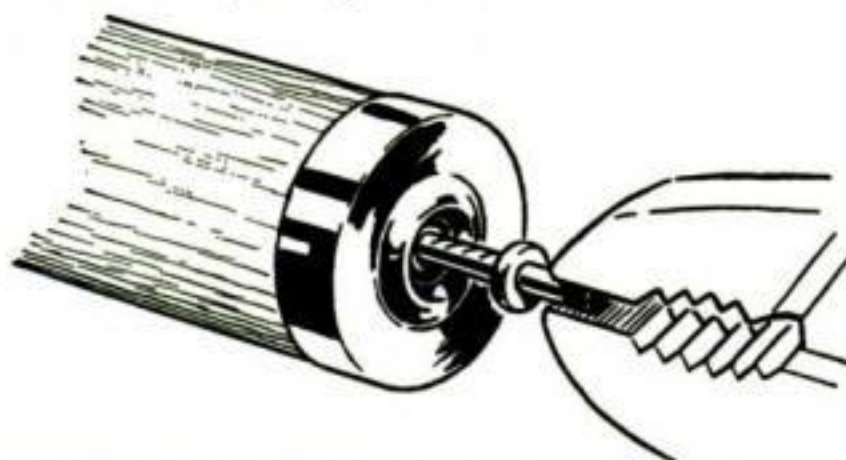
**KEEP OIL AWAY:** Pawls that drop into a notch are the secret of the locking device placed on every roller to keep the shade at the desired height. The pawls drop by gravity. Never oil them. An oil film eventually becomes gummy, and keeps the pawl from dropping.



**WHEN THE SHADE WON'T GO UP,** increase the spring tension by first pulling the shade down several turns. Remove the roller from the brackets, roll up the shade tightly, and return the roller to the brackets. If tension is too great, remove the roller once more, unwind the shade several turns, and put it back.



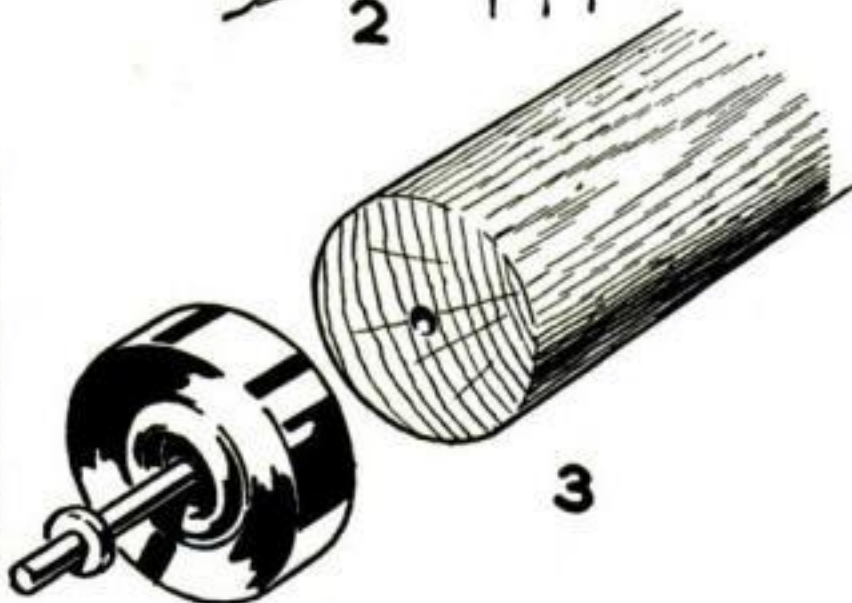
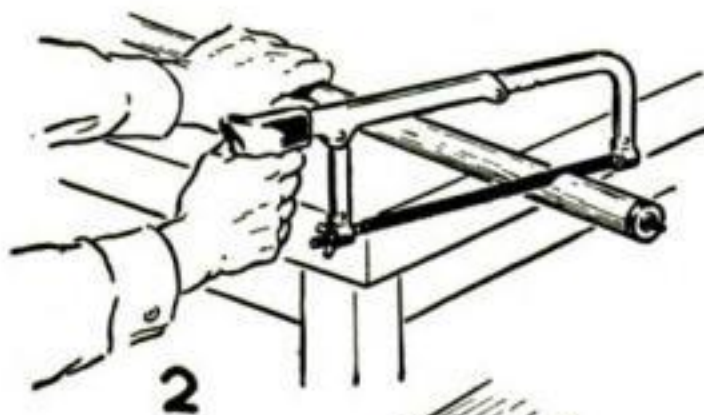
**ATTACH A NEW SHADE** to an old roller with care. Carpet tacks driven into the spring end of the roller may interfere with spring action. Use adhesive tape, a suitable adhesive, or small shade tacks that are sold for the purpose.



**ROLLER TOO SHORT?** This sometimes happens when you move a shade from one window to another, but there's an easy adjustment. Pull out the round pin at the non-spring end just enough so that the roller spans the brackets.



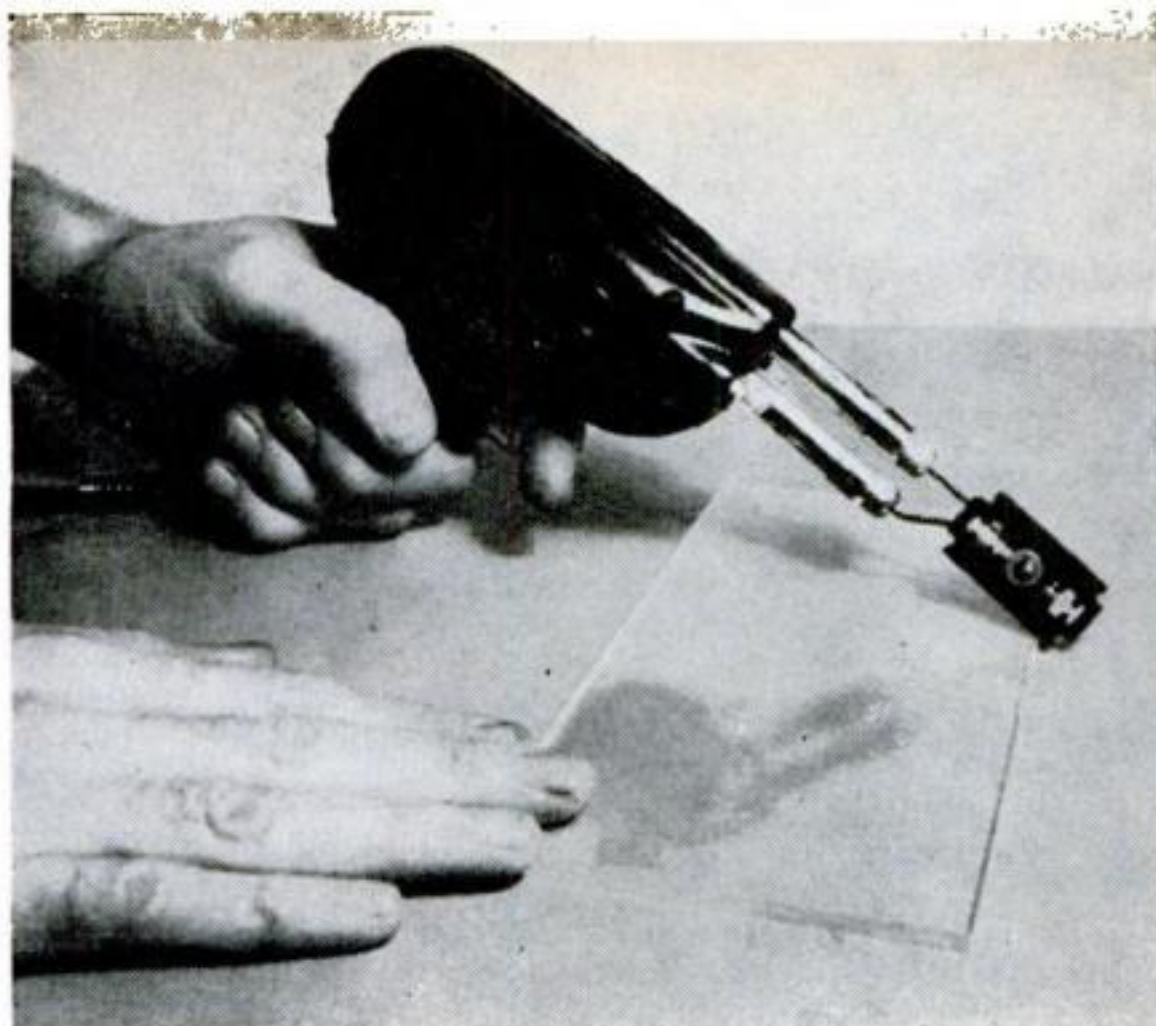
**AN OLD SHADE IN A NARROWER WINDOW?** It's easy to cut one down to a new size. Place the open shade and roller on a table. Carefully measure off the shade width desired so that you can discard the surplus at the pin end of the roller. Use a straightedge (1) to pencil a line from the bottom of the shade to the roller. Cut neatly along this line with shears. Then extract the pin with pliers, work off the cap, and saw off the surplus (2) from the end of roller. Fit pin and cap to the end of the shortened roller (3), and drive in the pin with a hammer.





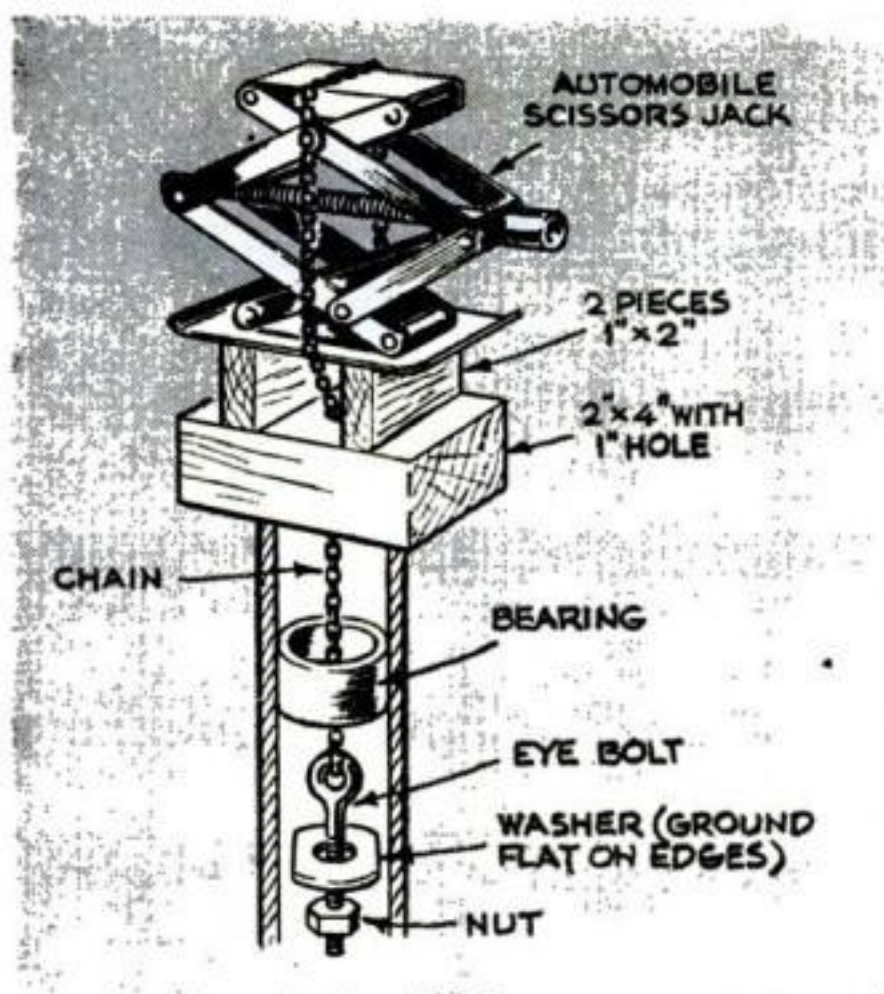
## Short Cuts and Tips

FROM PS READERS



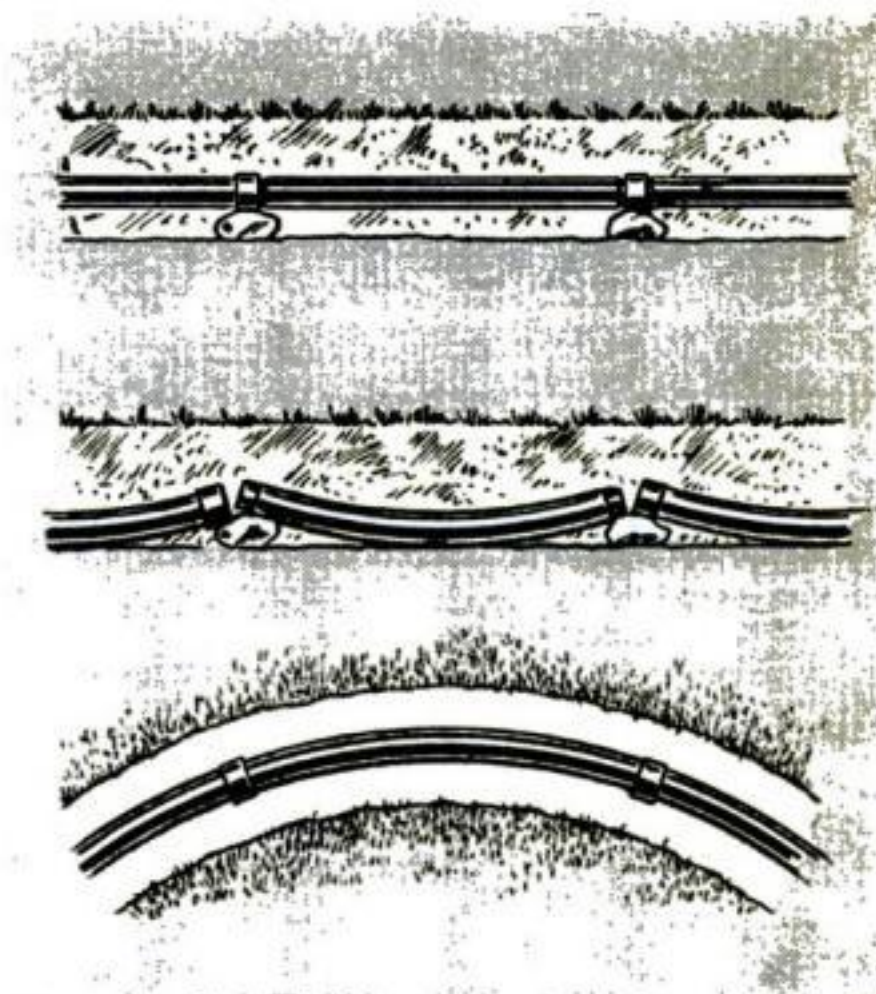
### Heated Blade Cuts Tile

A RAZOR blade, secured to the tip of a soldering gun with a machine screw and washer, makes fast work of cutting plastic tile (and some floor tiles). When you squeeze the trigger, the blade quickly heats up. The heat and sharpness of the edge make it slice through easily.—*John A. Comstock, Wellsboro, Pa.*



### Improved Bearing Puller

NOBODY would rent me a puller to remove a bearing from the center post of our washing machine, so I rigged up my own. I found a washer to fit inside the post and ground its opposite edges flat so it would slip through the bearing when tilted. I held it on an eye bolt with a nut, then dropped bolt and washer into the post on a chain fed up through a platform placed on top for my auto jack. The pulling force on the chain brought the washer flat against the bottom of the bearing collar and drew it up.—*Stephen J. Stephenson, St. Petersburg, Fla.*



### Sun Bends His Drain Pipe

TRYING to angle fiber drain pipe through a 25-degree bend in an open trench recently, I found it impossible to seat the 8' sections securely in the coupling collars. I wedged them in place and shimmed the line to level with a stone under each joint. When I got around to back-filling a few weeks later, I found that the heat of the summer sun had made each section sag to the ground at its center. Given a quarter-turn, they formed a continuous curve of just the right contour to bed the couplings firmly.—*Henry B. Comstock, Blauvelt, N.Y.*





**1 FOLD THE FLAG IN HALF** lengthwise. If it's longer than your reach, fold only taped end.

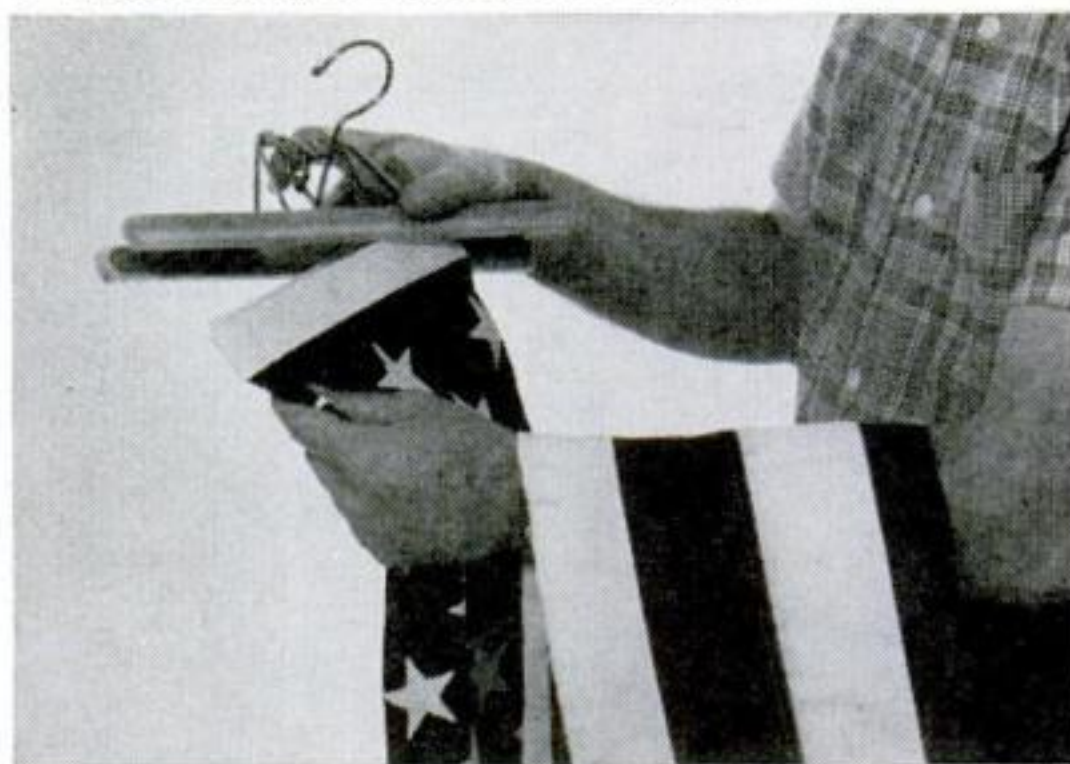
**How one person can do it:**

## **Furling the Flag in the Regulation Way**

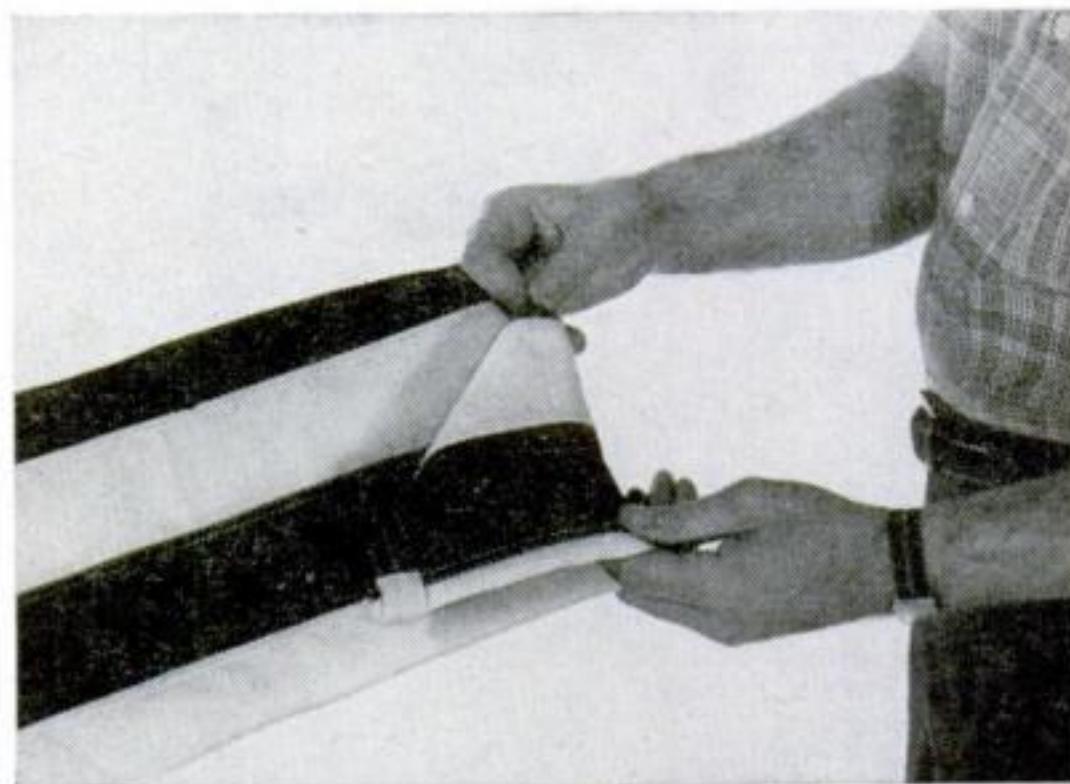
**T**RYING to fold a large flag is a ticklish job. But there's a way to do it quickly and smartly if you know how.

With Flag Day coming up on June 14th and the new 50-star Old Glory due to become official on the Fourth of July, now is a good time to brush up on proper flag procedure. Most of the rules are familiar: The U. S. flag takes precedence over all others, should have the blue field to the observer's left when hung flat, should not be draped, must be burned when discarded, and must never touch the ground.

This last rule is not so simple to observe when you have to handle a sizable flag all by yourself. The photos show the official method of folding the flag as prescribed by military, governmental, and civic organizations. The use of the hanger as an extra, unofficial aid makes an awkward problem an easy one-man job.



**3 TO HELP YOU HOLD THE FLAG**, clamp the taped end (blue field) in a skirt or pants hanger. Hold the other end carefully over your arm.



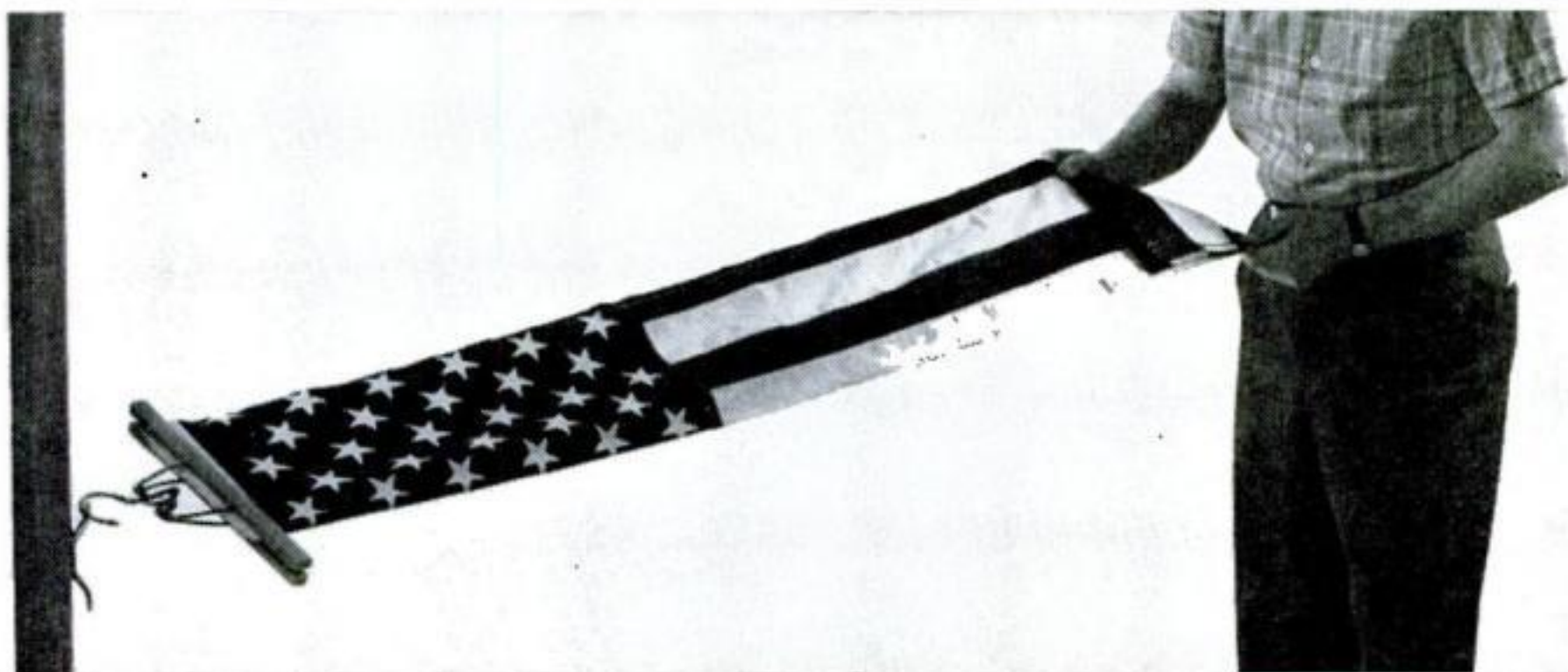
**5 CONTINUE FOLDING**, first along the square edge, then along the diagonal, forming a series of triangles wrapped inside each other.





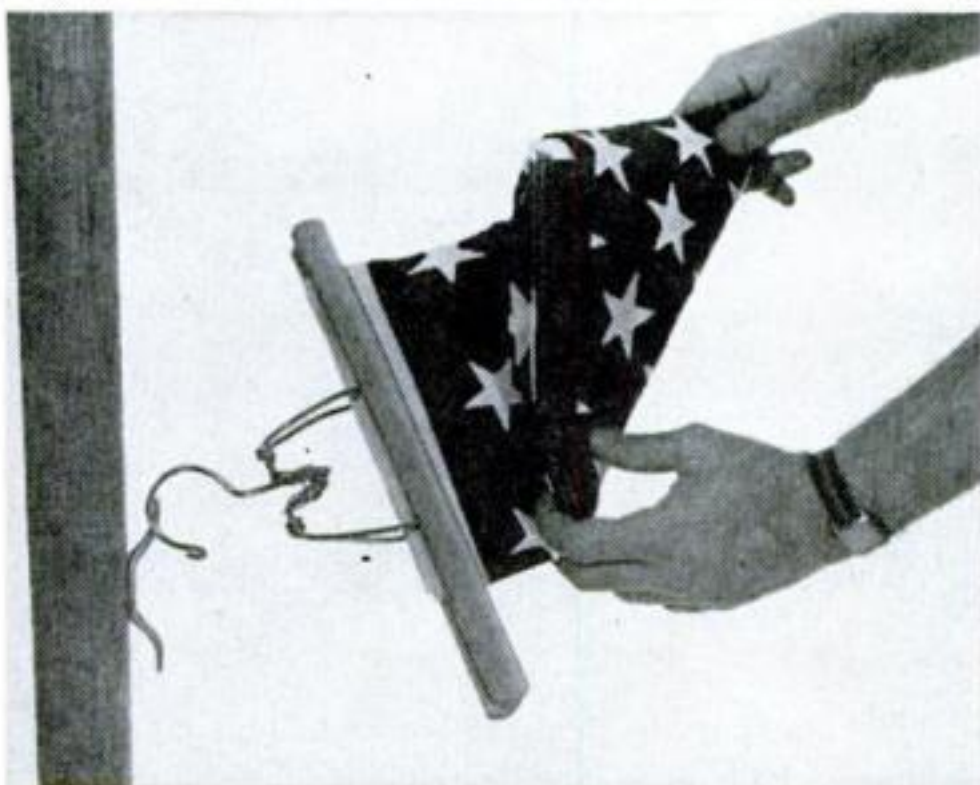
**2 FOLD IT IN HALF AGAIN**, being sure to keep the blue field on the outside of the fold.

Very large flags may require a third fold down the middle. Keep all folds neat and even.



**4 HOOK THE HANGER** to any convenient support, such as the halyard cleat on a flagpole. Pull the other end gently to straighten the

flag. Now start making triangular folds by bringing the corner on the folded side up and over to meet the edge along the open side.

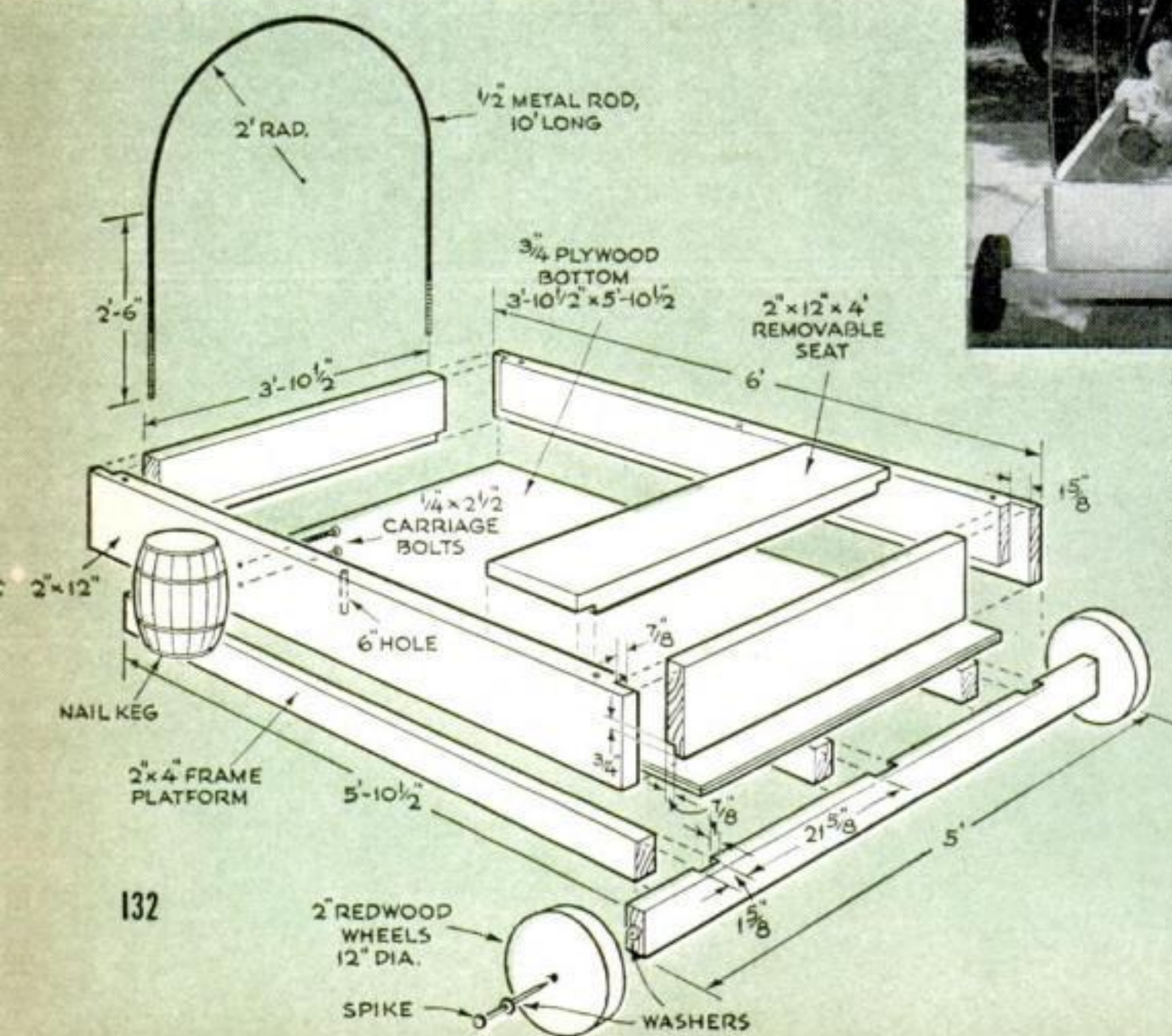


**6 WHEN YOU REACH THE HANGER**, release the flag and make the final fold in your hands. Keep the triangular folds neat and flat.



**7 TUCK THE TAPED EDGE** underneath the other folds to form a trim triangle resembling the soldier's cocked hat of Revolutionary days.





**FINE SAND** converts the schooner into a play box for toddlers. A quarter-yard or about 500 pounds is ample. Off-the-ground box and awning cover keep the sand dry and clean.



## HOW TO BUILD A

# Playtime Prairie Schooner

*Here's a rugged action center for young pioneers, pardner.  
It can be put up in any man's back yard*

**By Jerry Parker**

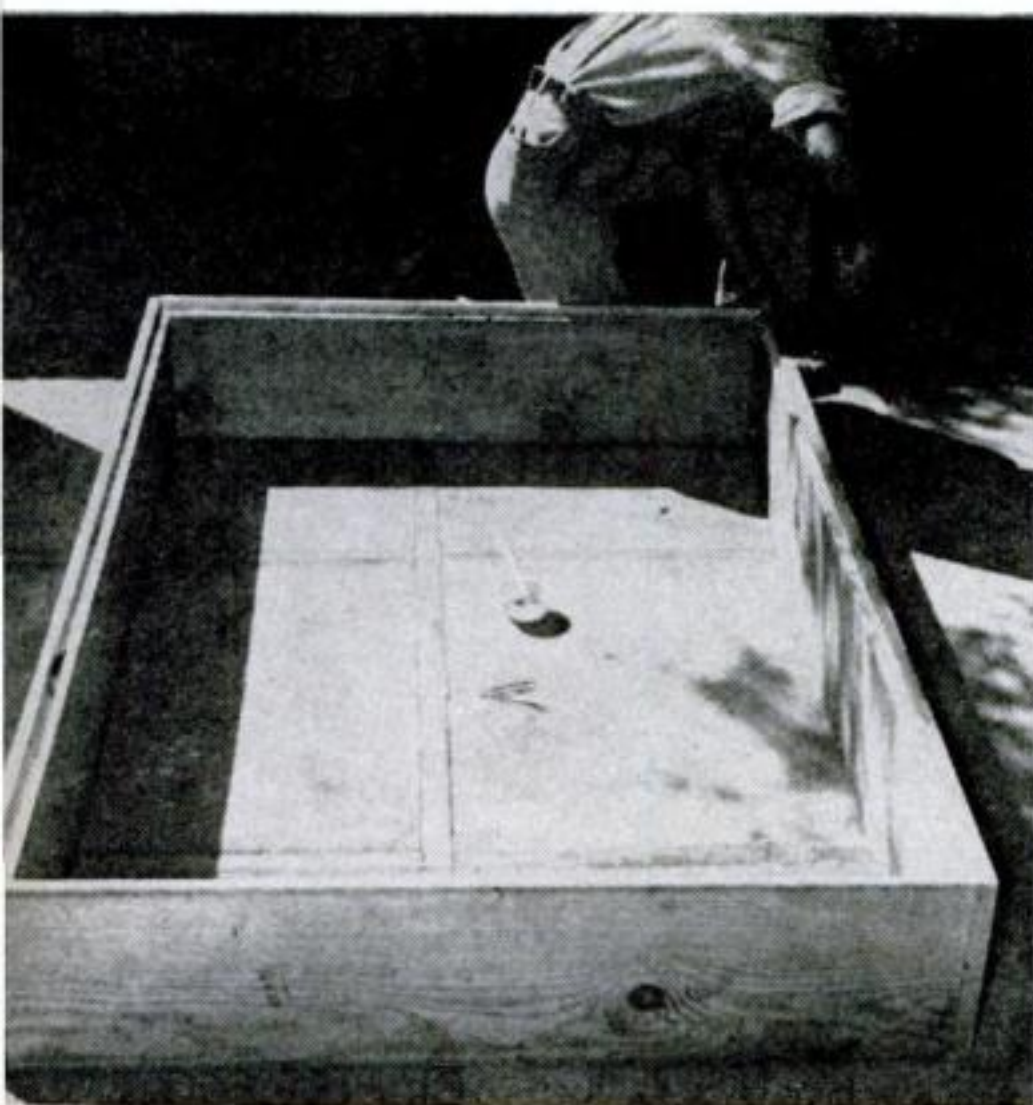
**C**OAX your young cowhands away from TV westerns and out into the fresh air with this kid-size replica of a covered wagon. One weekend's work and about \$25 in materials will make this a memorable summer for the youngsters.

The model shown has rabbeted joints, but you can stick to butt joints if you wish and alter the dimensions where necessary. The 4'-by-6' box, including a removable seat rabbeted on each end to hold it in place, is made of two-by-twelve

fir; two-by-fours are used for the platform frame.

The wheels, 12" in diameter, are cut from rough-sawn redwood 2" thick. The job is easy with a saber saw, especially if the saw is equipped with a circle-cutting jig.

If the box is to be filled with sand, the weight will hold it in place on the platform, but it can be fastened with screws or bolted through the center support. Attach each wheel with a large-diameter spike—80-penny or above. Shape the hoops from 10' lengths of 1/2"-steel re-



**BOX ENDS** are set into rabbets in side members, held by nails and waterproof glue. Lower edge of all four two-by-twelves is rabbeted to take 3/4" exterior-plywood panel for the bottom.



**PLATFORM FRAME** consists of five notch-joined two-by-fours. Wheels and projecting ends are predrilled for spikes, which serve as axles. A washer is put on each side of the wheel.

CONTINUED

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**BENDING HOOPS** is simplified if a master form is made by scribing a semicircle with a 2' radius on a wooden platform, and driving nails every 3" along it and the 2½' straight extensions.

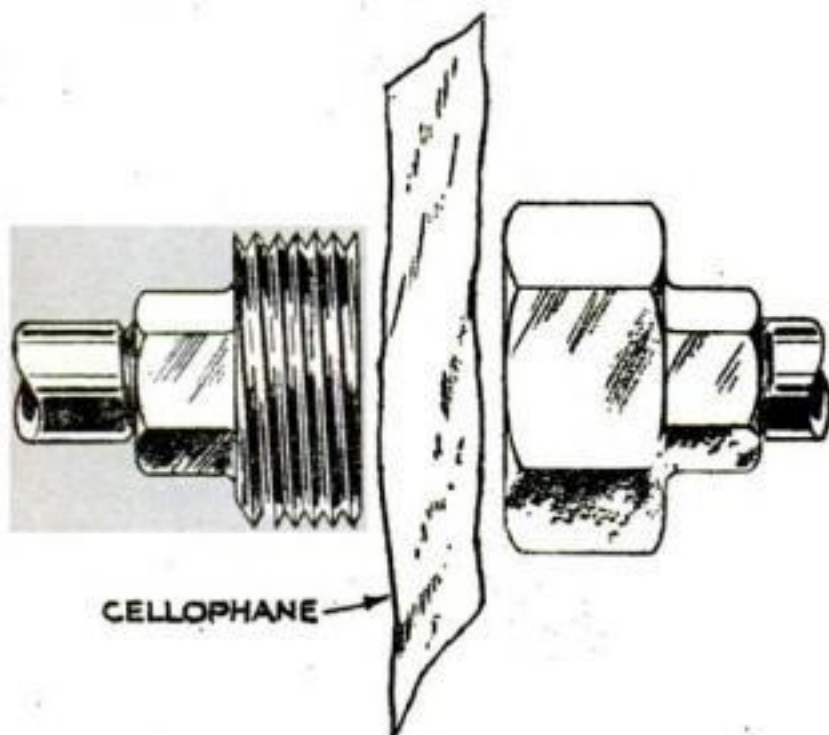


**STRAIGHT ENDS** are inserted in holes drilled into top edge of the box sides. Tension keeps hoops in place. A canvas tarp, old sheet, or blanket is draped over and lashed or sewn to hoops.

inforcing rods, as pictured just above.

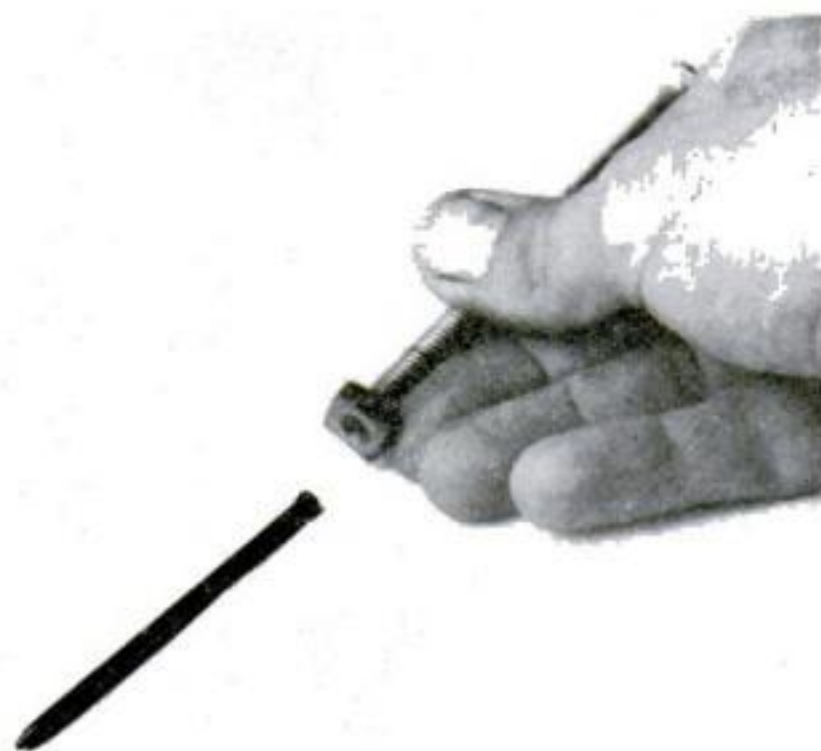
Canvas makes the best cover, especially if the ends are hemmed and slipped over the outside hoops. But a 5'-by-7' tarp can be lashed on instead, and the effect isn't

lost if the kids want to improvise with an old sheet or blanket. Leave the sides open for ventilation and visibility. Bolt on a nail keg; it provides storage for sand shovels and pails.



### Cellophane Cures Leaky Joint

WHEN a pipe union leaks due to a rough seat, I slip a piece of cellophane from a cigarette pack between the parts. There is no need to trim the overlap—it's cut off as you tighten the nut. Water pressure breaks through the thin film inside the pipe when you restore service.—George Healy, Hemet, Calif.



### Nailing in a Tight Spot

CRAMPED for space where a nail must go? Try an improvised nail holder. This consists of a bolt with a diameter a bit larger than the head of the nail. Thread on a nut just far enough to make it hold. Now you can hammer on the bolt; the nut will keep it from slipping off the nail head.—Robert Gannon, NYC.



# How I Fitted Oak Hydrofoils to My 14-Foot Runabout



***You don't know what you're missing until you try flying a boat. You can make the foils for \$25***

**By Herbert R. Pfister**

**T**HE most exciting water sport today is hydrofoiling. It's boating, but different. Underwater wings lift your boat out of the water and you take to the air—or so it seems. Freed from the water, the boat rides smoother and faster on less power.

If your boat is 16 feet or less in length, there's a good chance that you can equip it with foils. Aluminum foils are on the market now to fit most runabouts. They're fine. But you can get by with a lot less money by mak-

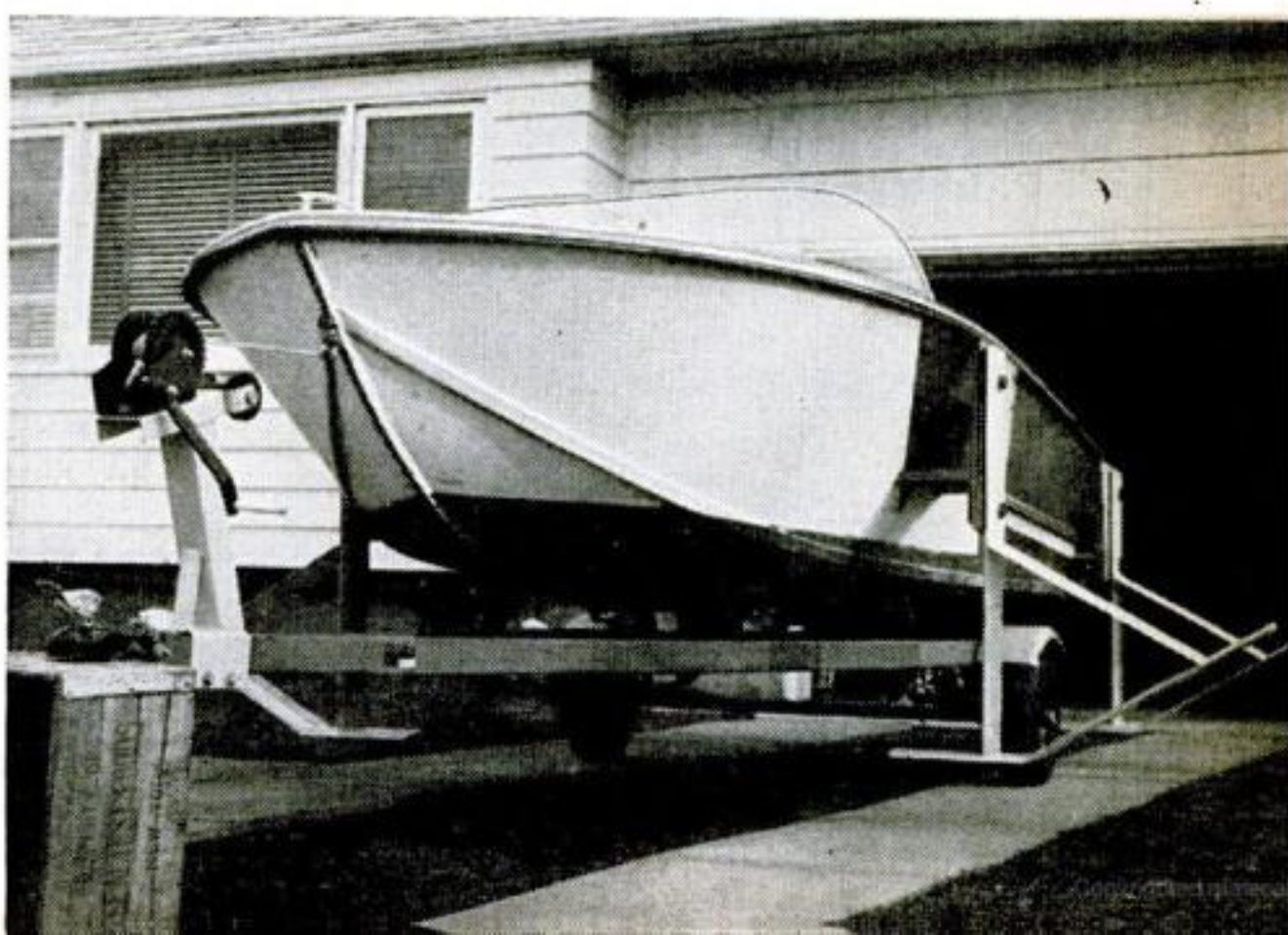
ing your own—out of good sturdy oak.

If you can work with wood, you can make foils. You shape them on a table saw. You'll find the details illustrated in last month's *POPULAR SCIENCE*. There's also a big blueprint to help with the job.

These foils were designed for the *POPULAR SCIENCE* Flying Platform Boat—a special fun boat built on a four-by-eight-foot sheet of  $\frac{3}{4}$ " plywood—but they're

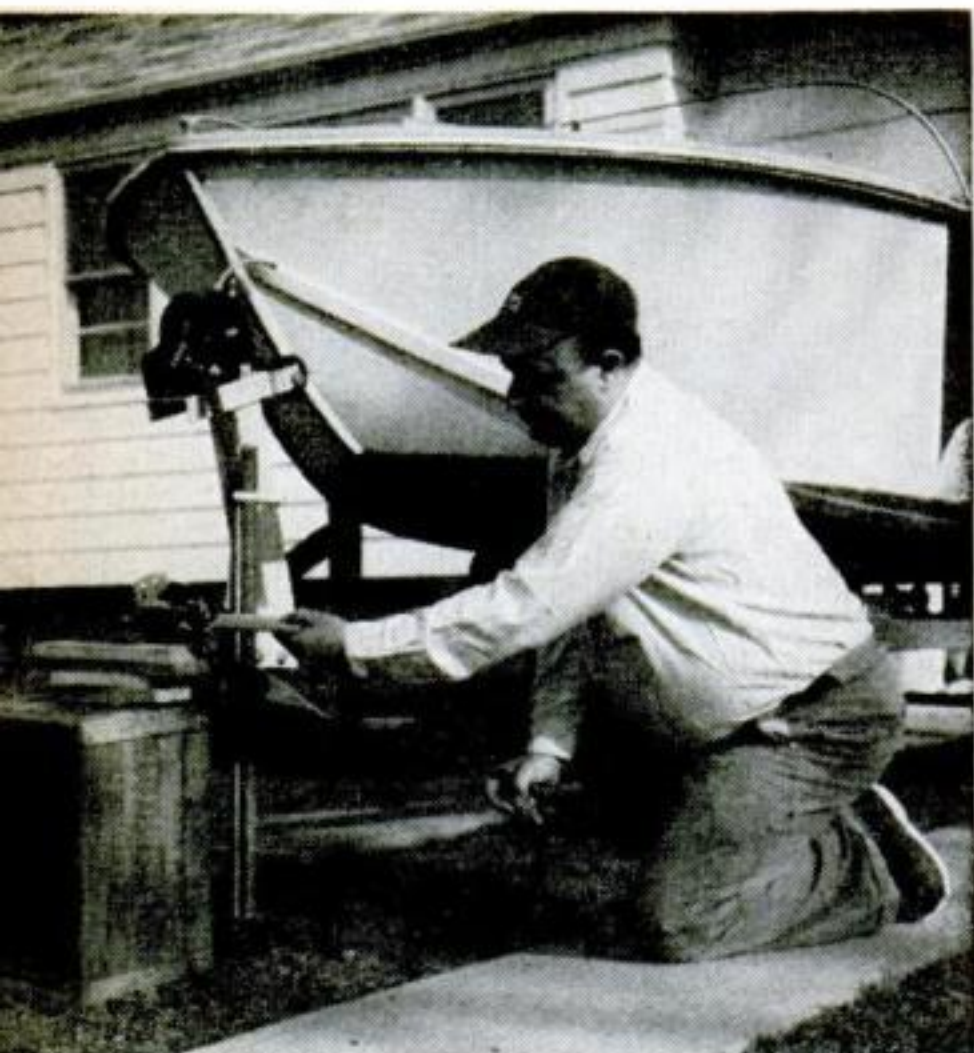
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**REAR FOILS** are shorter than front, but sloping sheer line makes up the difference. Foils should come out parallel to keel and approximately in line with prop center of a long-shaft motor.





## Level the boat before installing the foil supports



**JACK UP THE TONGUE** of the trailer until the keel is level, then prop it with a box and pieces of wood. Raise one trailer wheel, if necessary, to level the hull across the gunwales.

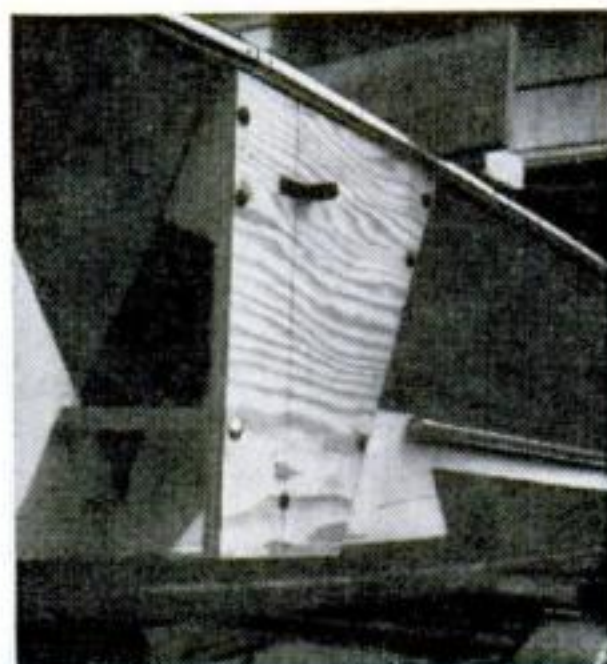
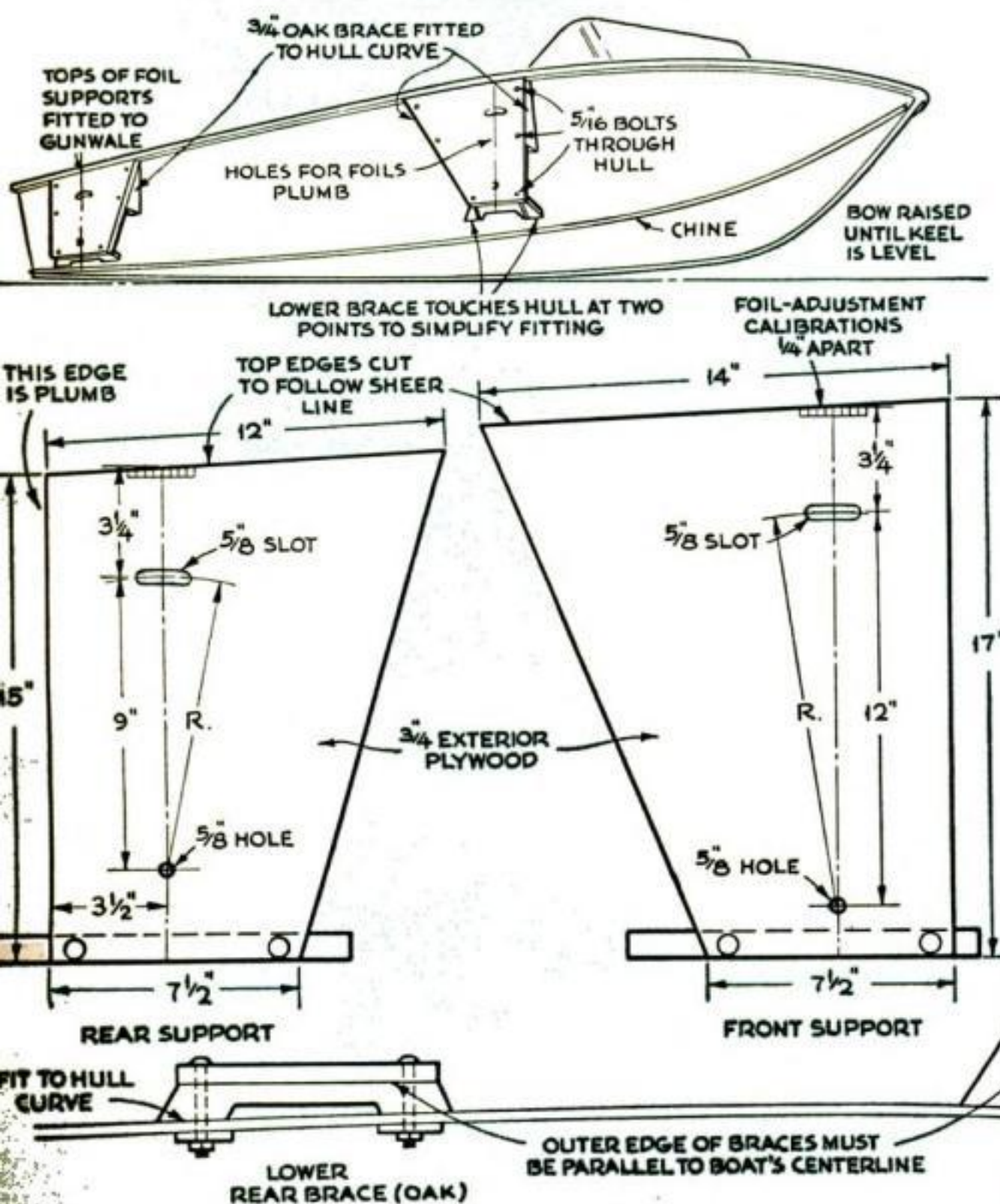
able to fly a conventional small boat, too.

Photos and drawings on the following pages show how I fitted foil supports to the sides of my 14-foot plywood hull. Broad braces on the supports distribute strain over a wide area, making the installation equally suitable for thin-skinned aluminum and fiber-glass boats. Slots in the supports permit on-the-water adjustment of the foil angle to suit the boat's trim and payload.

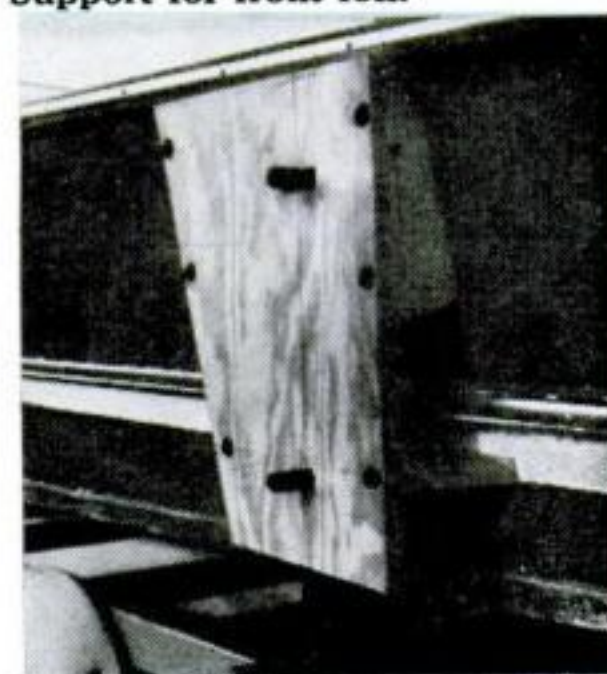
No modifications should be necessary to fit the oak foils to your boat. The tandem arrangement supports the hull at four points, so balance and foil location aren't critical. Regardless of your boat's length, mount the front foils a bit forward of the front seat, the rear ones just ahead of the transom.

Two bolts hold each foil in place. These can be removed quickly when you want to beach or dock the boat. A hinged arrangement can be added to swing the foils up out of the water when not in

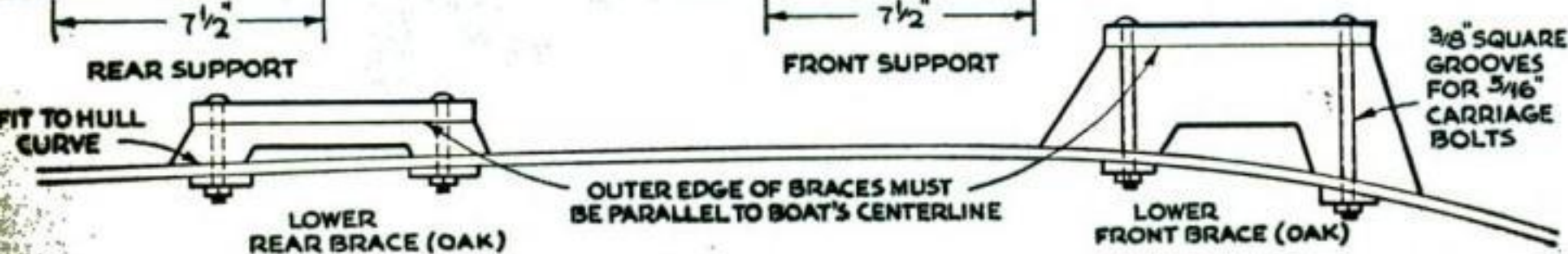
*[Continued on page 212]*



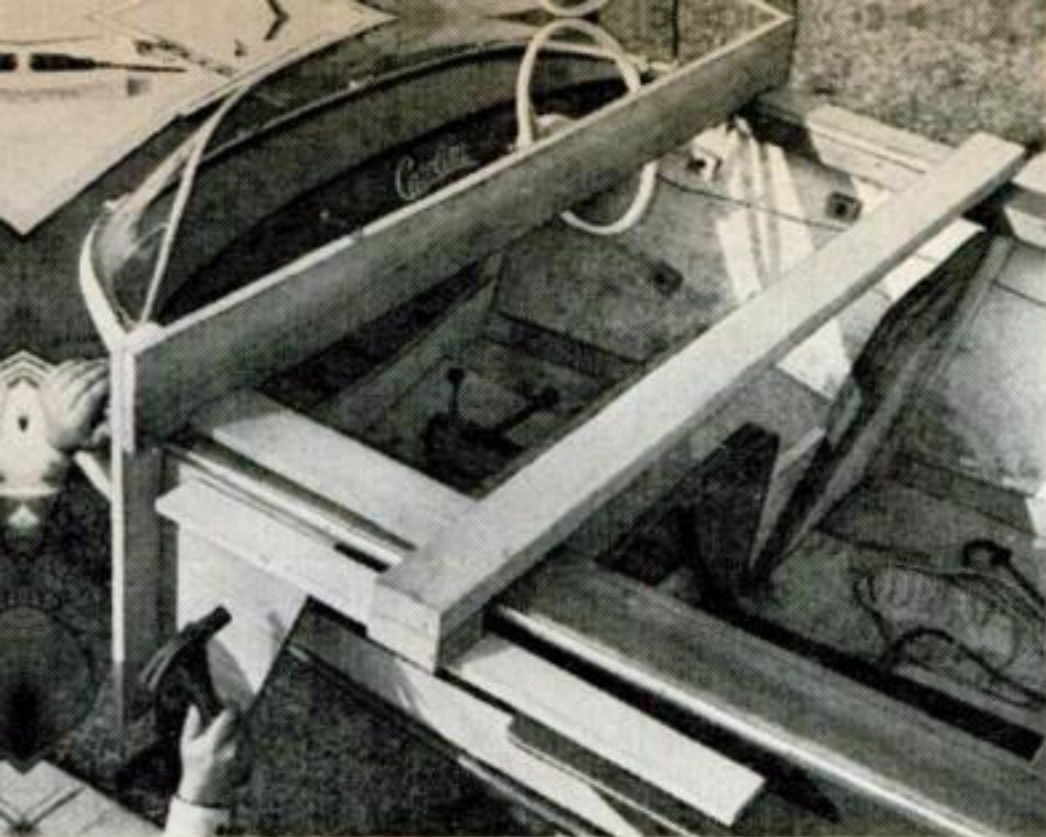
Support for front foil.



Support for rear foil.







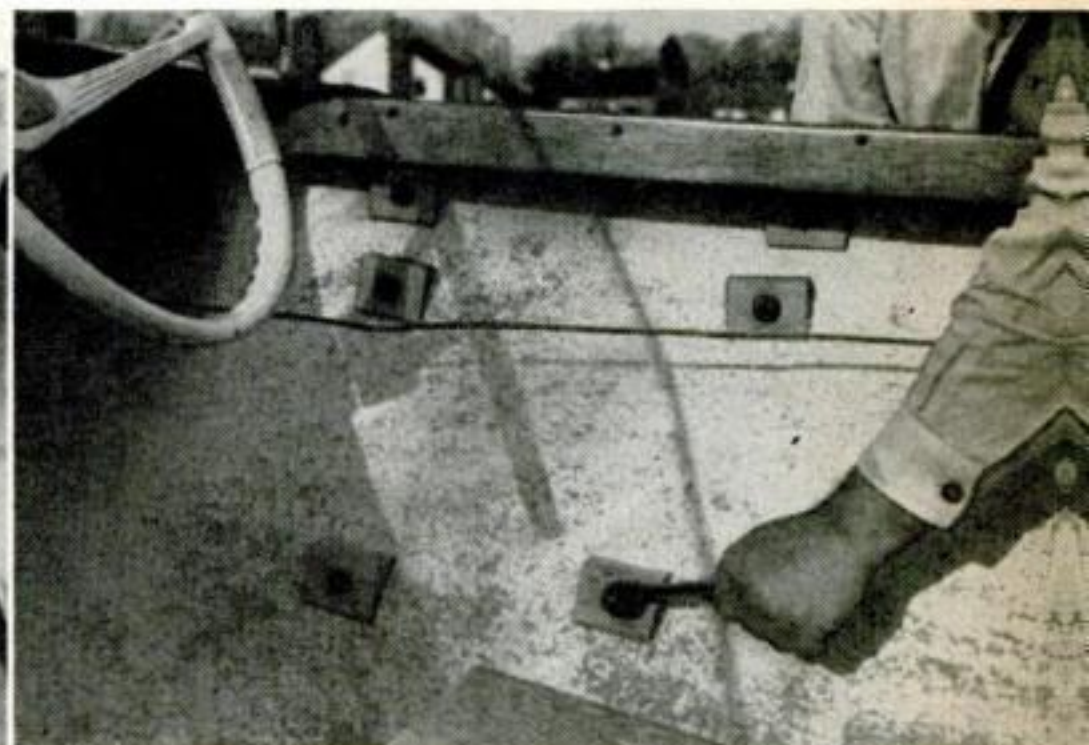
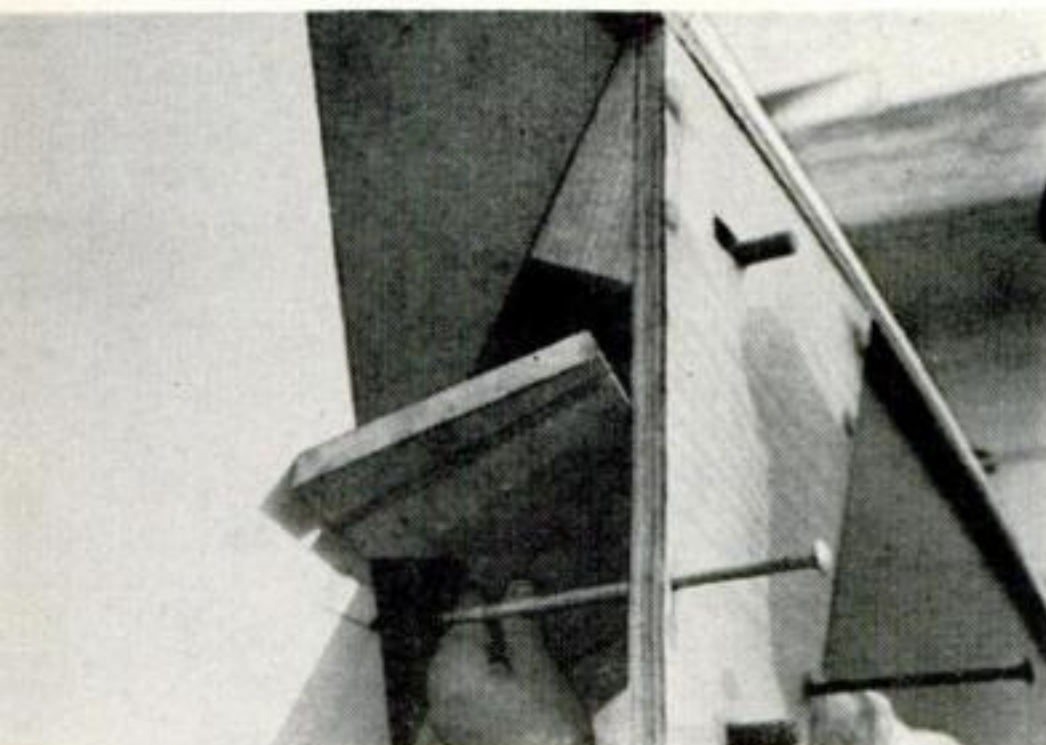
## ***Foil supports must be plumb and parallel to boat's centerline***

**LARGE HOMEMADE SQUARES** align the foil supports. Use L-shaped square at left to set the supports at 90 degrees to gunwales, T-square in center of photo to aim them straight ahead.

**DRILL FRONT FOIL SUPPORT AND HULL** for long carriage bolts needed because of hull curve toward bow. Fit wide lower brace and cut  $\frac{3}{8}$ " grooves in underside to house the bolts.

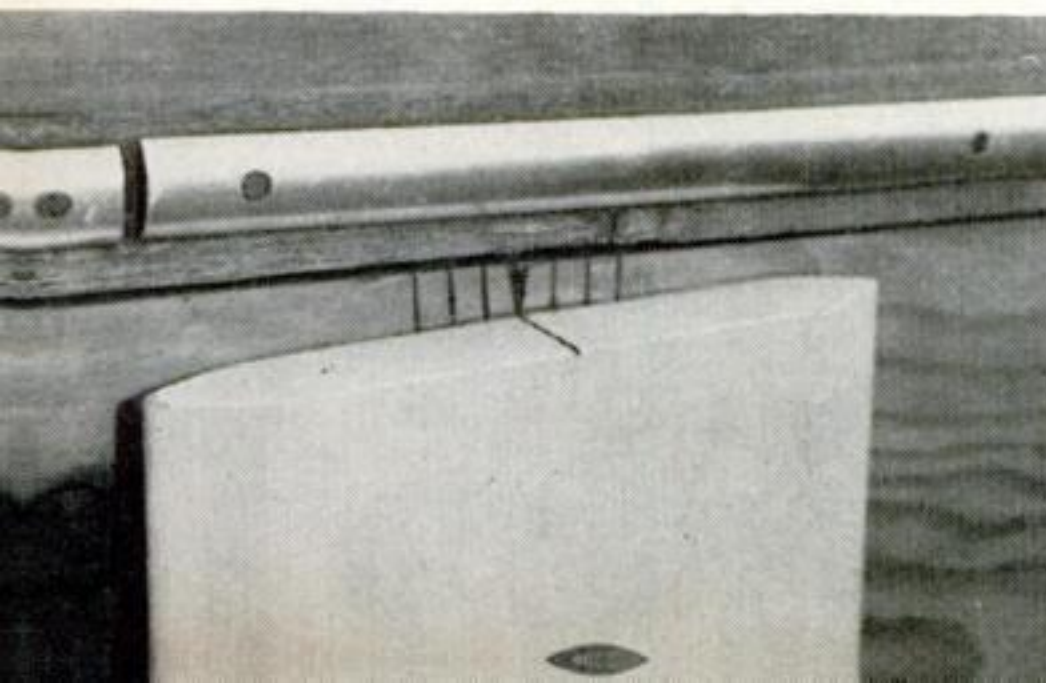
**WITH JACK HOLDING SUPPORT IN PLACE**, mark and cut top braces to fit between support and hull. Glue braces to support, then drill through them and into hull for  $\frac{5}{16}$ " carriage bolts.

**USE WEDGE-SHAPED WASHERS** of oak inside the hull to provide a flat surface for tightening lock nuts. If foil supports are removed, holes in hull can be sealed with short carriage bolts.



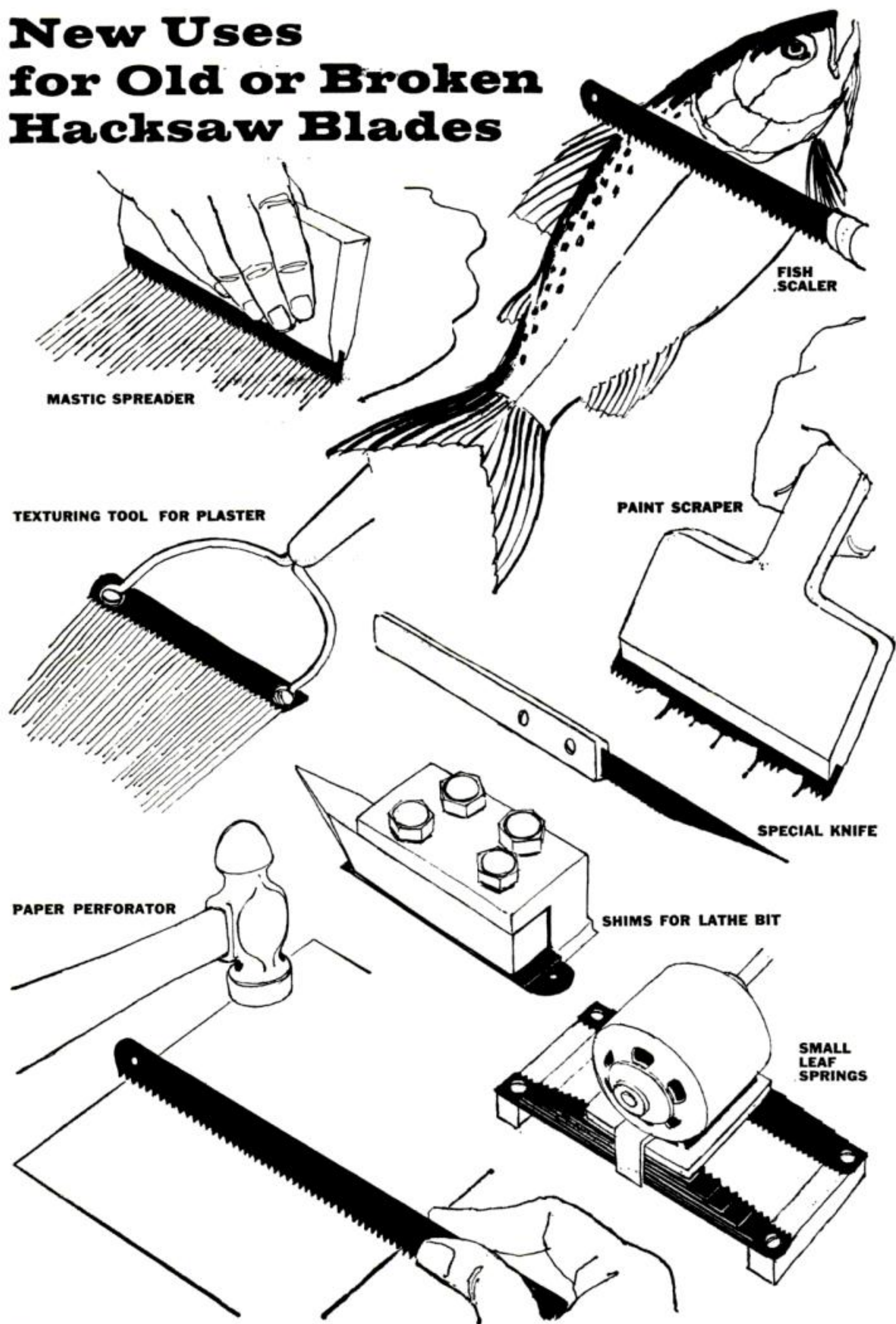
## ***Plumb foils on land, adjust them later in water***

**MAKE INITIAL SETTING OF FOILS** while keel is level. Mark plumb position, then measure off three  $\frac{1}{4}$ " graduations on each side (below) to aid in making adjustments on trial runs. You get most speed when foils are set for least angle of attack. Increasing "up" angle adds lift, slows boat. Tether wrench to a foam block, which will float in case you should drop it overboard.





# New Uses for Old or Broken Hacksaw Blades







## Short Cuts and Tips

FROM PS READERS

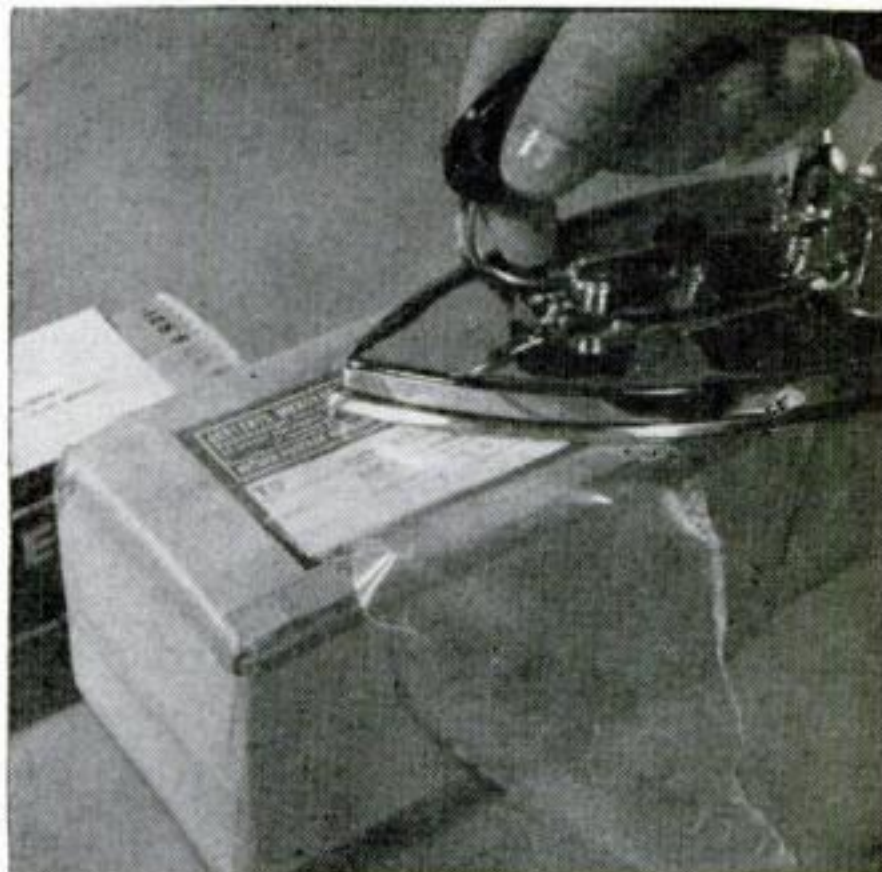
### Paper Cup Is Emergency Funnel

A CONICAL paper cup makes a good emergency funnel if a regular one is not available. Just cut  $\frac{1}{8}$ " off the bottom. This makes it ideal for such jobs as pouring water or antifreeze into windshield-washer reservoirs, or oil into steering boxes. For radiator filling, enlarge the bottom hole.—*B. Jackson, Downsview, Ont.*



### Hand Rail for a Toddler

AFTER our toddler took a tumble down the front steps, I added a child-scaled hand rail. A length of  $\frac{1}{2}$ " copper tubing passes through a one-by-four and is flattened on the ends for attaching plates. The masonry was drilled for anchor plugs.—*Bernard Rimland, San Diego, Calif.*

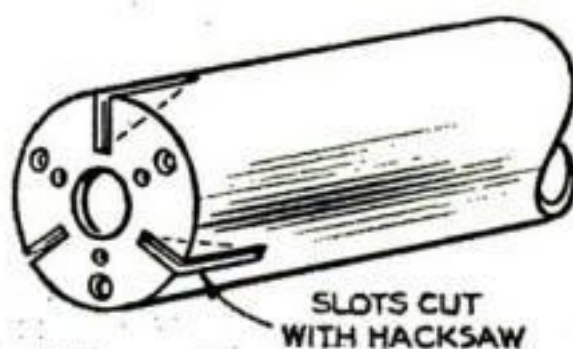


### How to Weatherproof Labels

AFTER you have attached written or typed mailing labels to a package, lay a sheet of waxed paper over it and press the area with an iron set for its lowest (rayon) heat. The wax transferred to the label surface makes the address waterproof.—*Ken Murray, Colon, Mich.*

### How to Improve a Torch Tip

SLOTS hacksawed between the preheat holes of the cutting tip for an oxyacetylene blowpipe help when you're burning starting holes in heavy plate steel. They keep slag from clogging the holes and eliminate frequent pauses to clean the tip.—*Harold D. Burgess, Battle Creek, Mich.*







**An old pail, a tin can,  
and my wife's vacuum  
cleaner did the trick:**

# I Forge Metals in a Bucket

**By Don Engdahl**

**F**OR a few cents and an hour's work, you can have one of the oldest shop tools—a real, working forge capable of producing high enough temperatures for brazing, casting, toolmaking, tempering, and even welding. The secret is an old bucket to hold the fire, a tin can, and a pile of rocks. In place of the smithy's bellows, this modern forge gets its air supply from my wife's vacuum cleaner.

This forced-draft forge gets so hot that at full draft it can make a piece of steel disappear in a shower of sparks. To make it, cut a hole in the side of a pail near the bottom just big enough to let you force in the metal tube that fits on the end of the vacuum-cleaner hose.

Next, punch small holes in the bottom of a tin can and cut another hole in the side to match the vacuum-cleaner tube. Place the can, punched end up, at the

bottom of the pail. The vacuum cleaner, hooked up to blow instead of suck, forces air into the bottom of the bucket to create a draft. The tin can fits over the end of the tube and acts as a chimney—called a “tuyere” in smithy talk—to direct the air up to the top of the bucket.

The pail is then filled with rocks that serve as a grate. Build up the rocks to within an inch or two of the top, then add the fuel. Charcoal briquets work well for many low-temperature jobs, but for most general work a high grade of soft (bituminous) coal is the stuff to use. The coal is transformed into coke as it burns and it is the intense heat of this process that provides the high temperatures.

Start the fire with wood chips, then turn on the vacuum cleaner, keeping the air flow very low at first. The flow can be controlled by loosening the coupling in the cleaner's hose to bleed off some of the air, or by partially blocking off





**FORCED AIR** from the vacuum cleaner enters the bucket through tube inserted in its side. A tin can, turned upside down with holes punched in the bottom, is slipped over the tube to act as a chimney and channel air upward. Then stones are packed around the can.

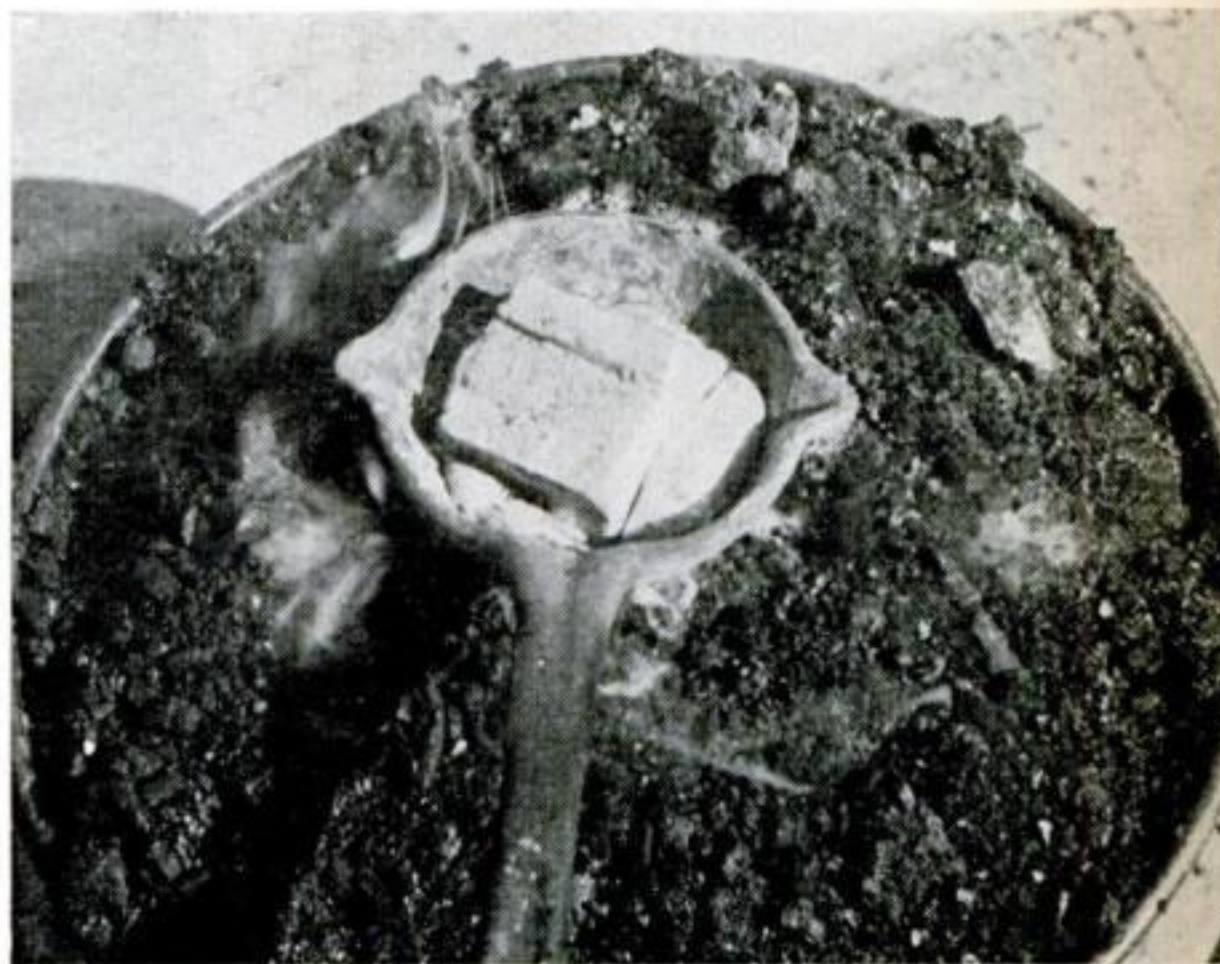
the intake, which reduces the volume of air that's pumped by the vacuum cleaner.

As the fire catches, gradually add more fuel, building up a crater of red-hot coals in the center of the bucket. Pack earth around the fire in the form of a cone to force the air up through the center and to keep the fire from spreading. Plunge the work into the coals and cover it over as completely as possible, leaving only a small opening to insert the brazing rod. Watch your draft carefully to avoid generating excessive heat that may actually burn up the metal.

One caution: If you shut off the vacuum cleaner while the fire is still burning, there's a chance that coal gas may seep back into the cleaner and cause an explosion when you turn on the electricity again. To avoid this, always disconnect the cleaner from the forge while it is still blowing before you turn it off. You can do this by uncoupling the hose from the tube so that you can leave the tube attached to the bucket.



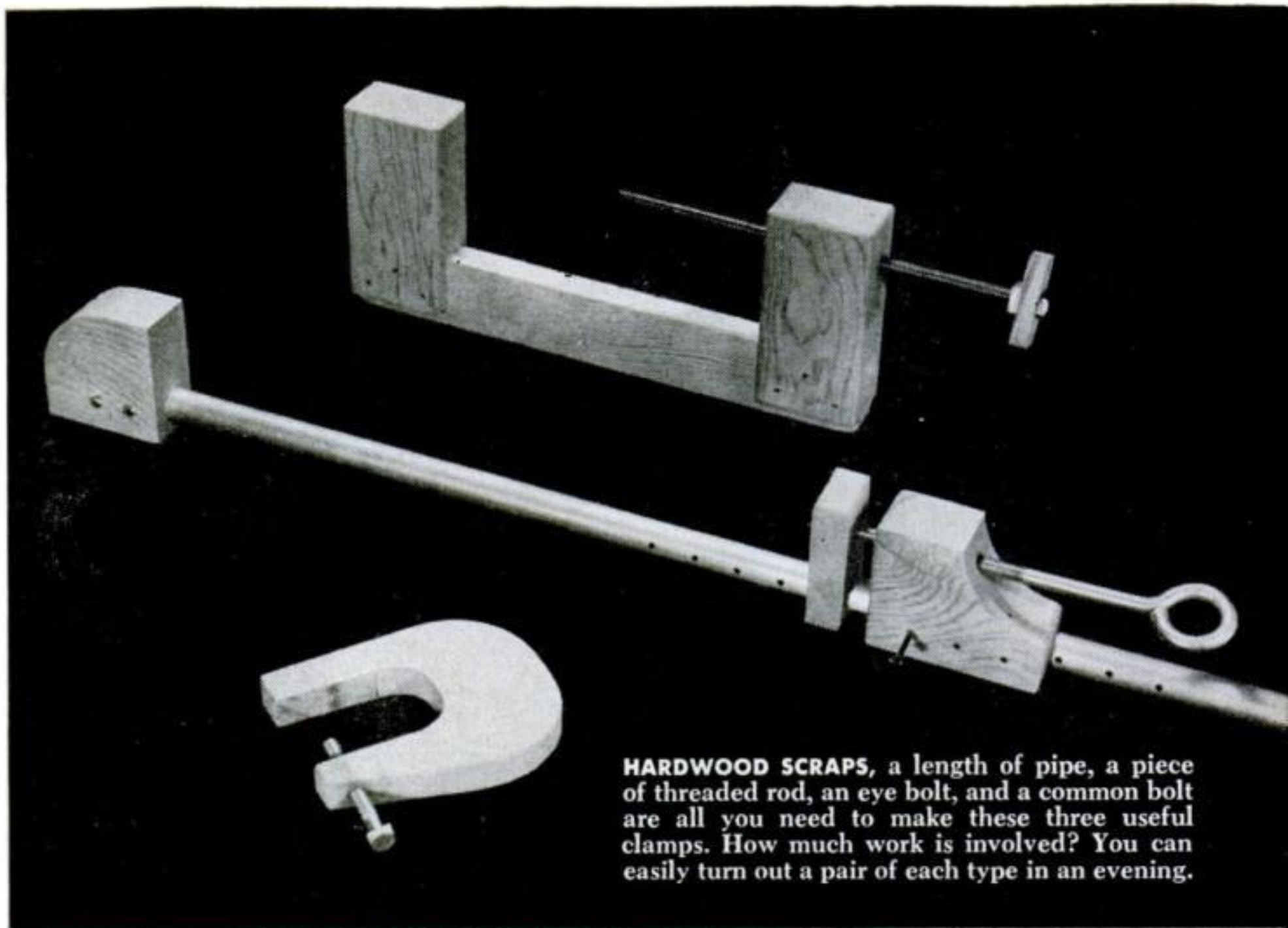
**HOT ENOUGH TO BRAZE STEEL**, the homemade forge easily mends these bike handlebars. The plastic handgrips were able to be left on without damage because of the rapid dissipation of heat. Charcoal briquets, used here, provide medium heat; coal gives even higher heat.



**METALS MELT QUICKLY** when held over the top of the forge. This aluminum bar is just beginning to puddle at the bottom of the ladle. Below, the molten aluminum, almost watery, is poured into a tin can used as a mold.







**HARDWOOD SCRAPS**, a length of pipe, a piece of threaded rod, an eye bolt, and a common bolt are all you need to make these three useful clamps. How much work is involved? You can easily turn out a pair of each type in an evening.

# Homemade Clamps

By **R. J. De Cristoforo**

**B**UYING enough gluing clamps for all your woodworking needs can put a painful squeeze on your pocket-book. Fortunately, it isn't necessary. In a couple of evenings you can turn out a fine set from scratch. Conventional clamps, bar clamps of any capacity, corner clamps—they'll cost you only pennies and will last a lifetime. What's more, their construction is just challenging enough to make the project fun, and the tools themselves will be a source of pride whenever you use them.

Remember that all clamps do their jobs by exerting pressure either by pushing or pulling. A good clamp produces this pressure easily, and applies it exactly where it's needed, with the help of a work-holding frame.

The frame must be tough, to hold up under continued use, as well as continuous pressure. For this reason you should

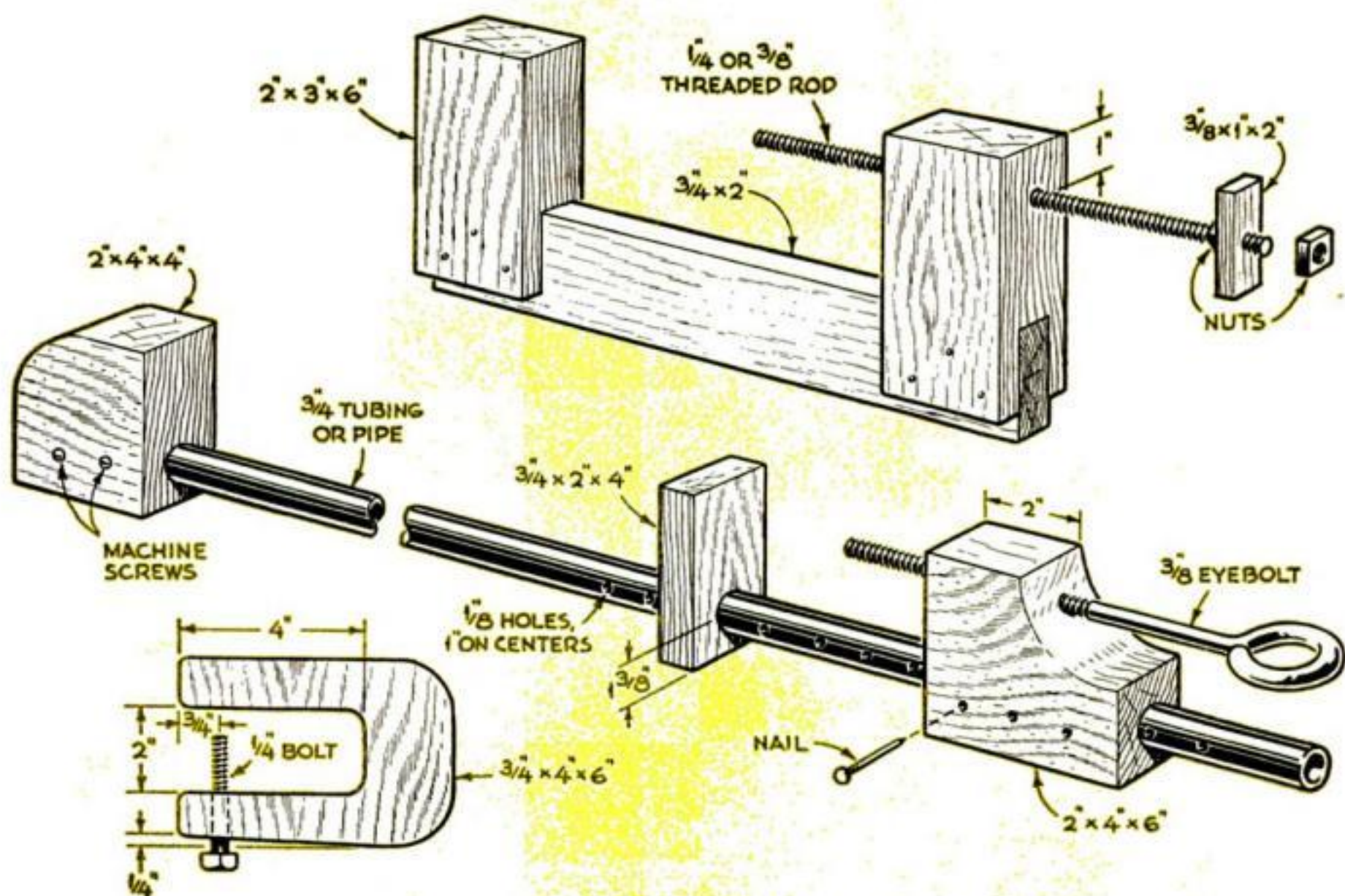
use close-grained hardwood for your homemade clamps. Birch and maple are good. Where frames must be built-up assemblies, bond the parts together with wood screws and glue.

Now for the "push" or "pull" mechanisms: A wedge or a cam—again cut from hardwood—can exert terrific thrust. So can a common bolt, threaded properly through a hardwood frame. An inexpensive turnbuckle produces comparable pressure with its pulling force.

Make sure that any frame surface that will bear against parts being clamped is squared accurately against the line of thrust. And when you come to threading bolts through hardwood, keep in mind these useful tips:

Drill and tap the wood just as you would metal—with one important exception. Use a tap drill that is a couple of sizes smaller than usual. The tap will have no trouble forcing its way through the tight hole, and, in the process, it will





# for the Woodworker

compact the surrounding stock, producing strong mating threads.

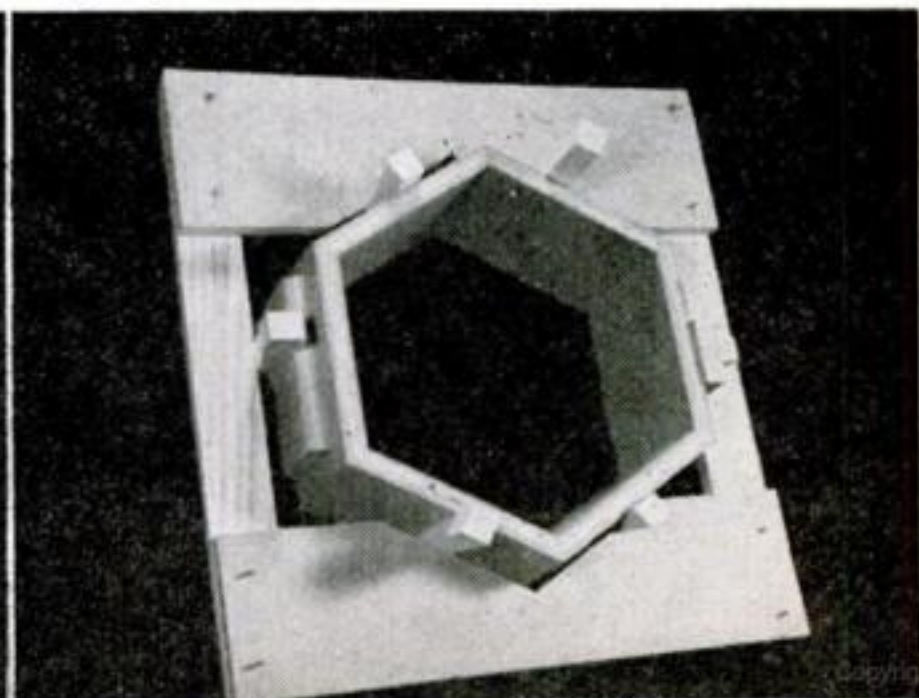
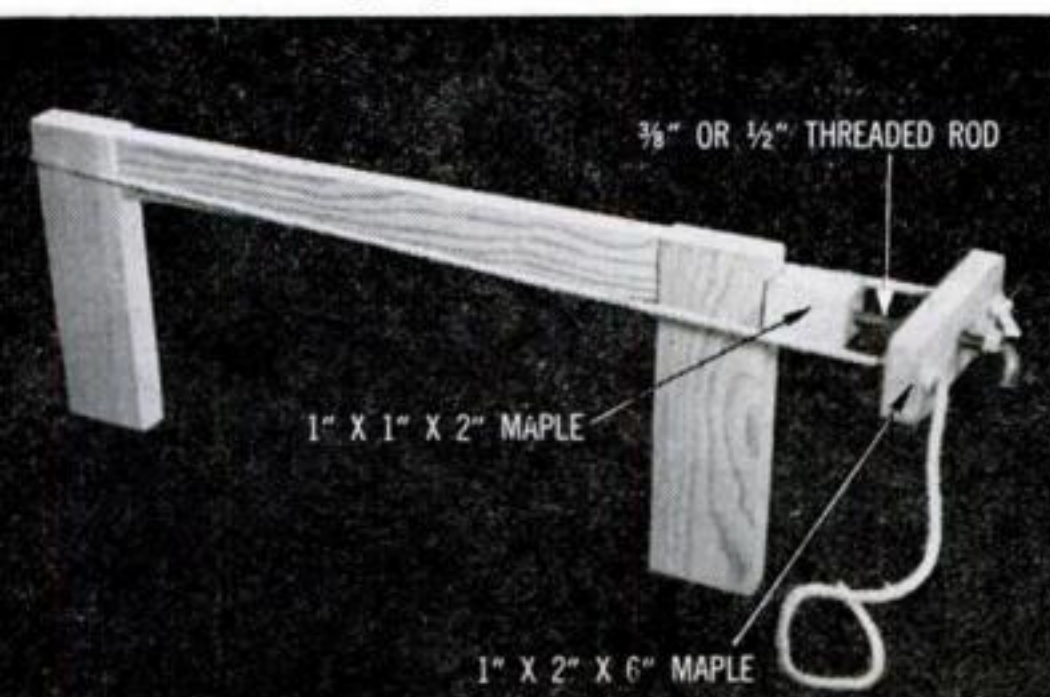
If you don't own a set of taps, let the clamping bolt do the threading job itself. Taper its end slightly for easy starting, and apply a bit of oil. Or, if you're dealing with very hard wood, heat the bolt

before cranking it through. This serves the double purpose of making the threads cut easily and of hardening the stock. Try this on a bit of scrap wood first to determine the right amount of heat. Too much will scorch and weaken the work. Underheating is better.

CONTINUED

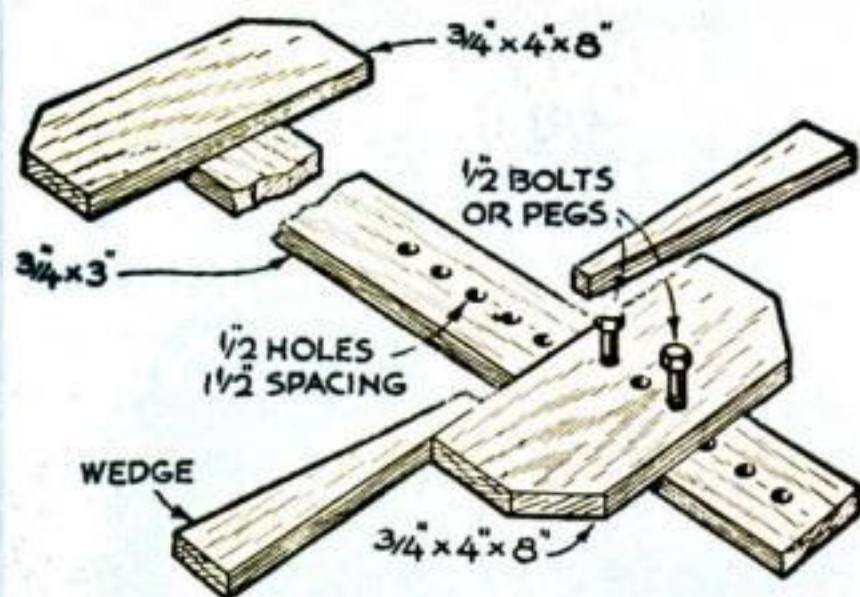
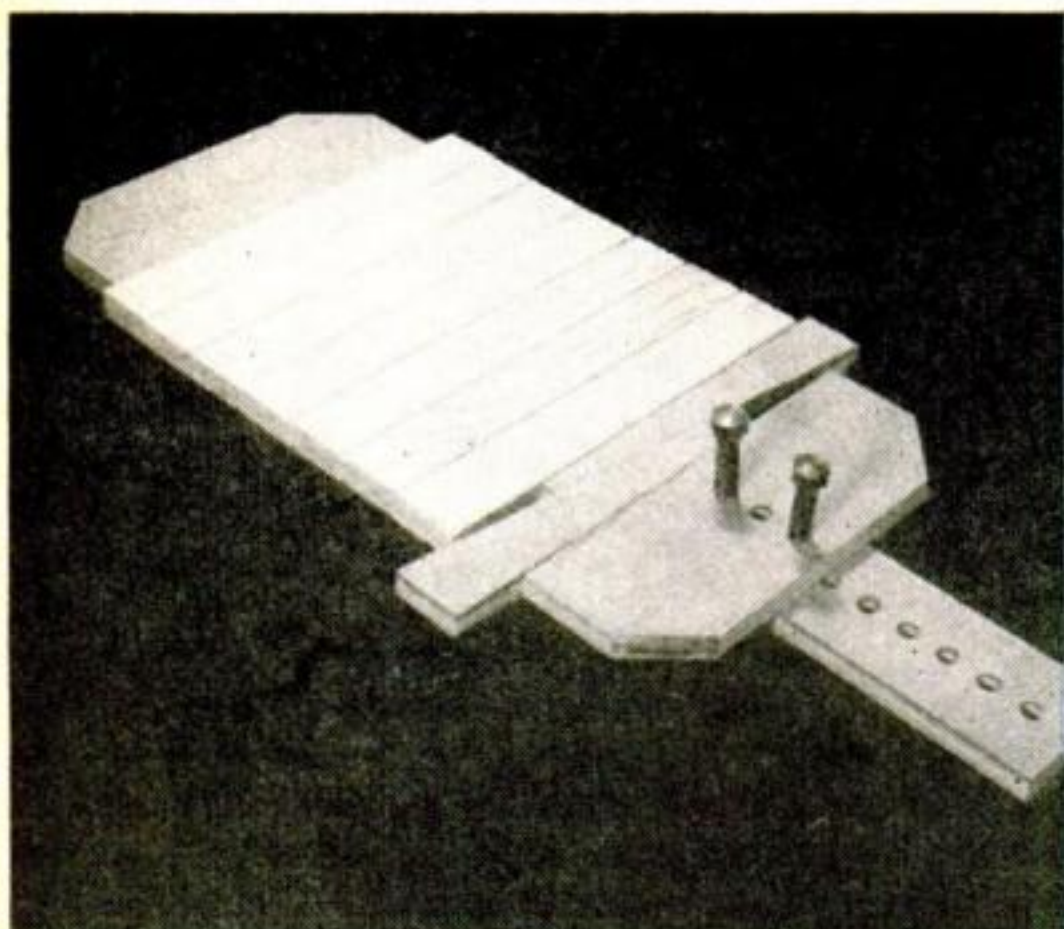
**ROPE CLAMP** is easy to make. It's fine for many irregular jobs, as well as oversize standard ones like the leg-and-rail assembly shown below. Don't use clothesline, though—it will stretch, and loosen, if placed under continuous tension.

**MULTI-SEGMENT CLAMPING RIG:** Not a clamp you'd use often, but handy when you need it, this one puts the squeeze on the work by means of wedges. You set them all in place, then tap appropriate ones to line up the corners.

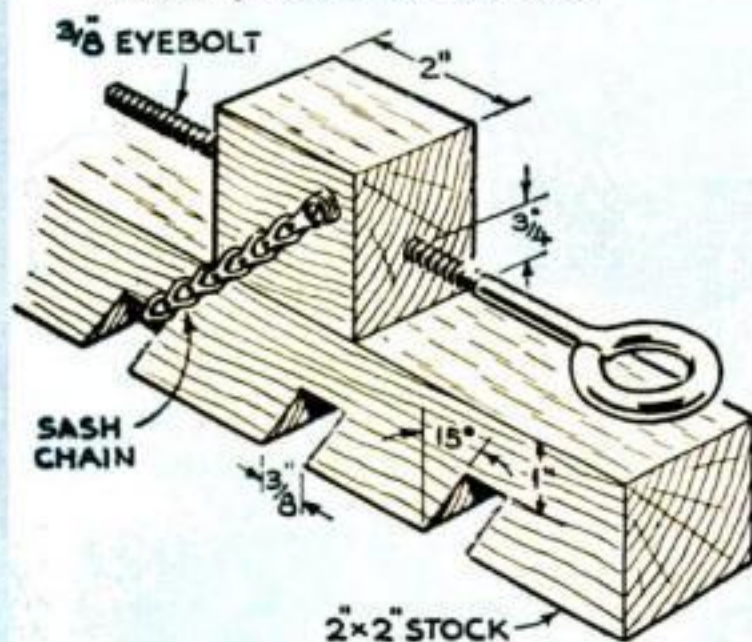
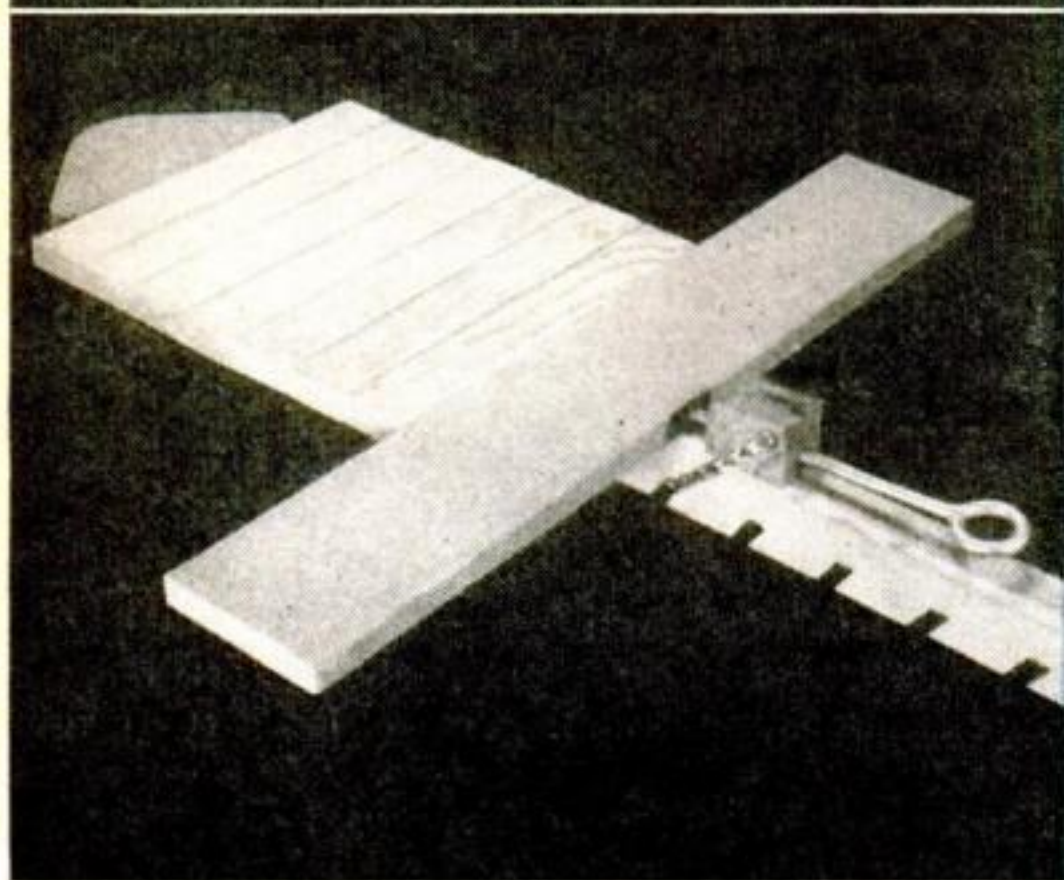




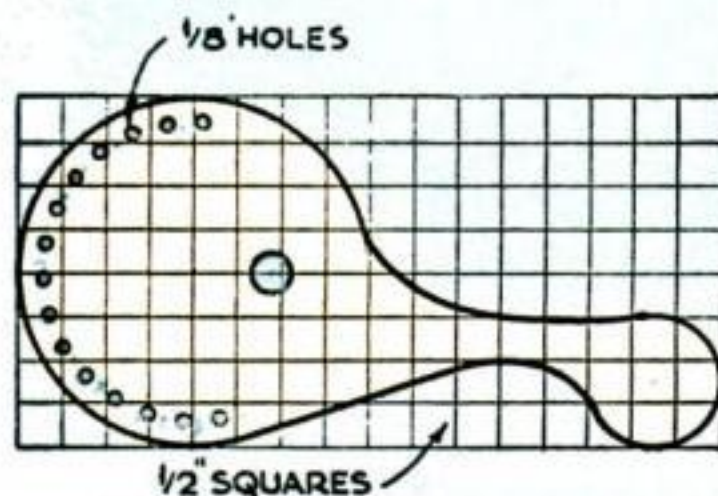
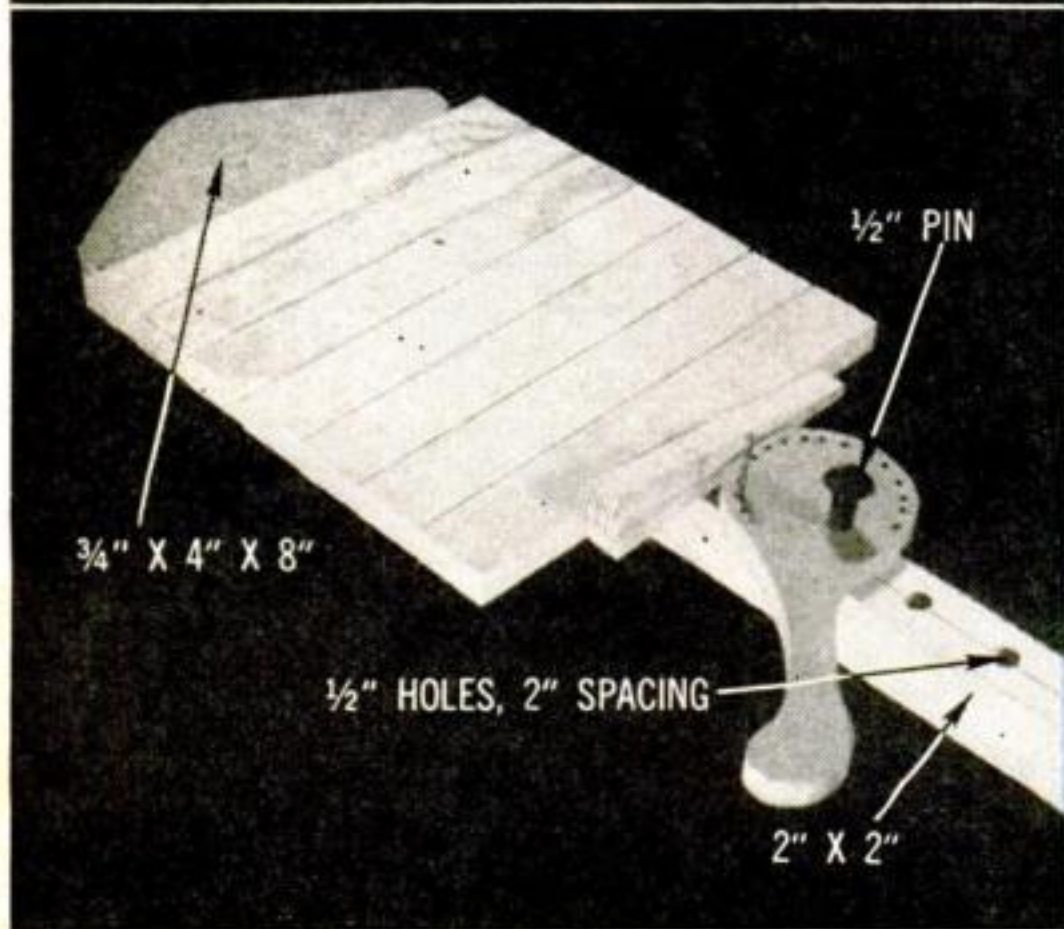
### 3 ways to produce bar-clamp action



**WEDGES DO THE TRICK:** The backing block of this clamp is moved forward as far as possible and pinned to the bar with a pair of bolts. Light taps on the wedge ends then put even pressure on the parts to be bonded.



**SCREW ACTION** is just as effective as wedges. Here, slanted notches and a section of sash chain provide a means of adjustment. The chain should be just long enough to slip along the bar when not engaged in a notch.

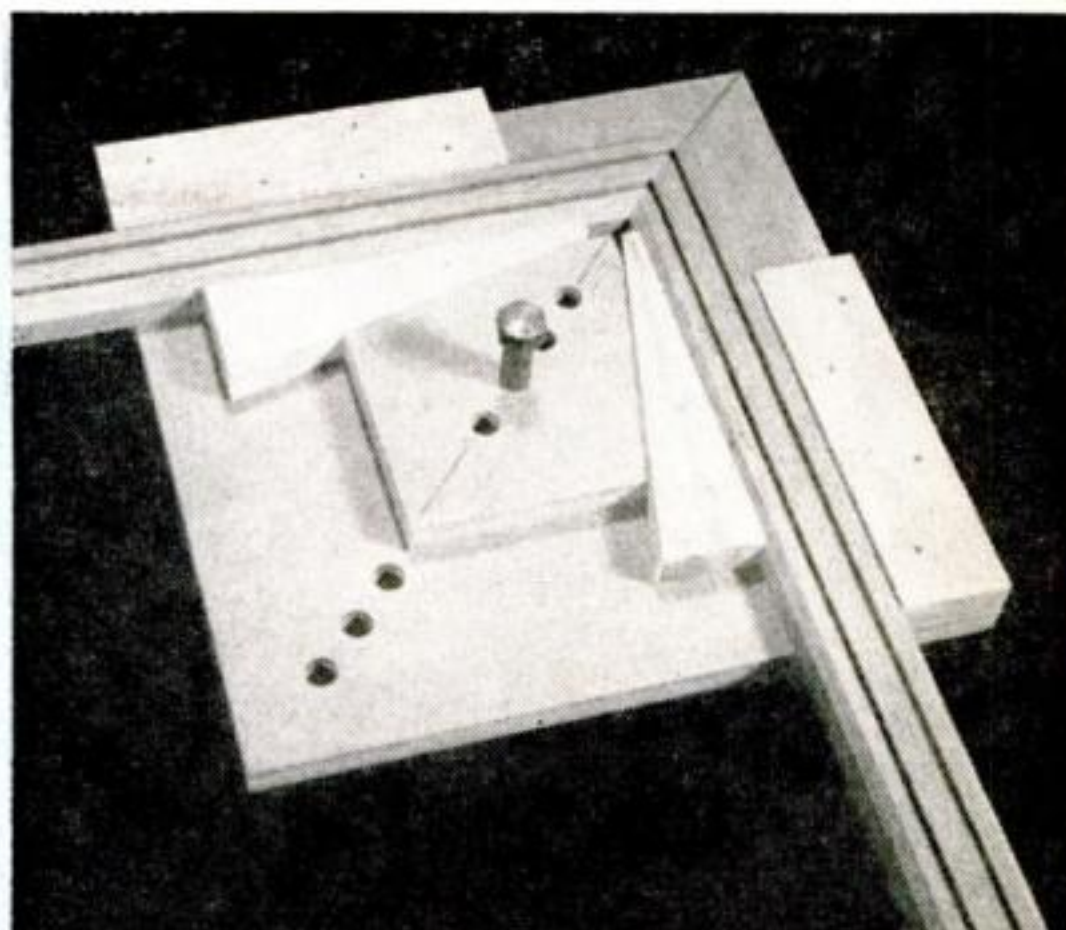
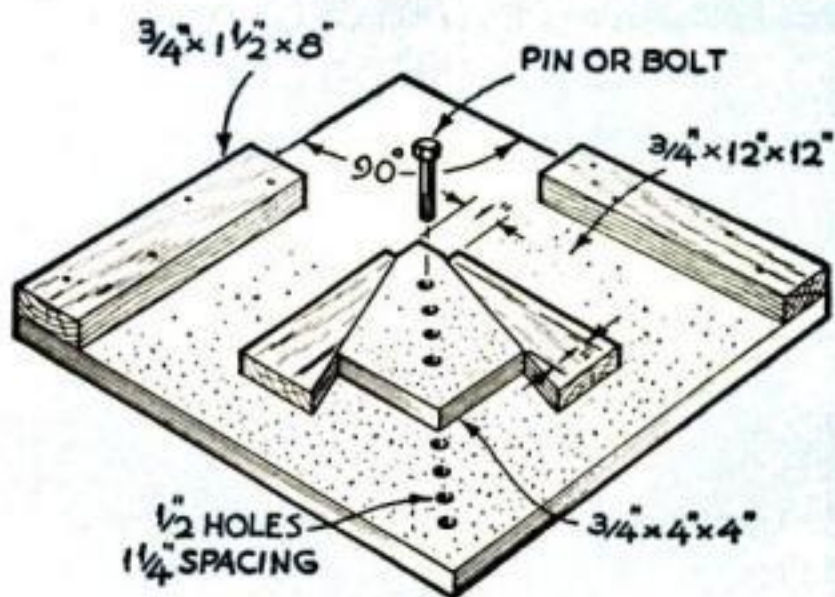


**LEVERED CAM** exerts strong pressure, too. It pivots on a bolt at the most convenient hole and is locked in place with a nail that butts against one side of the clamping bar. Use a scrap block to cushion the edge of the work.

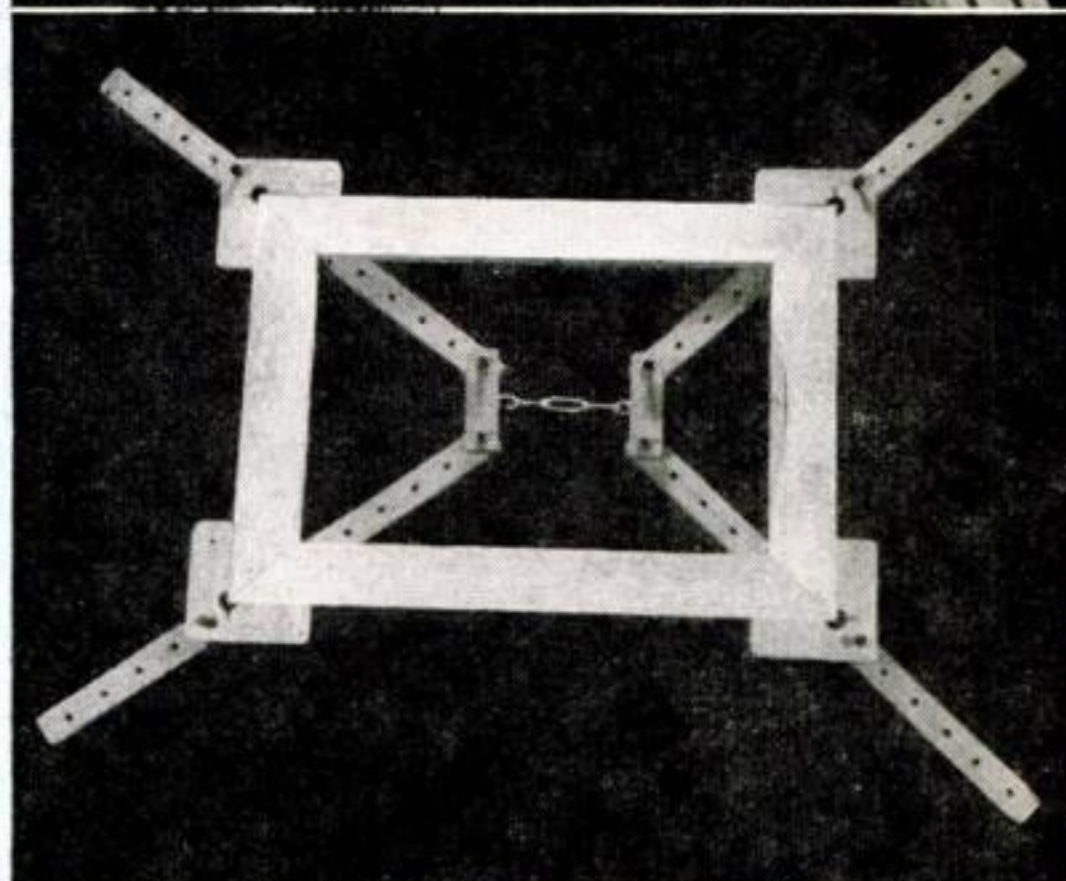
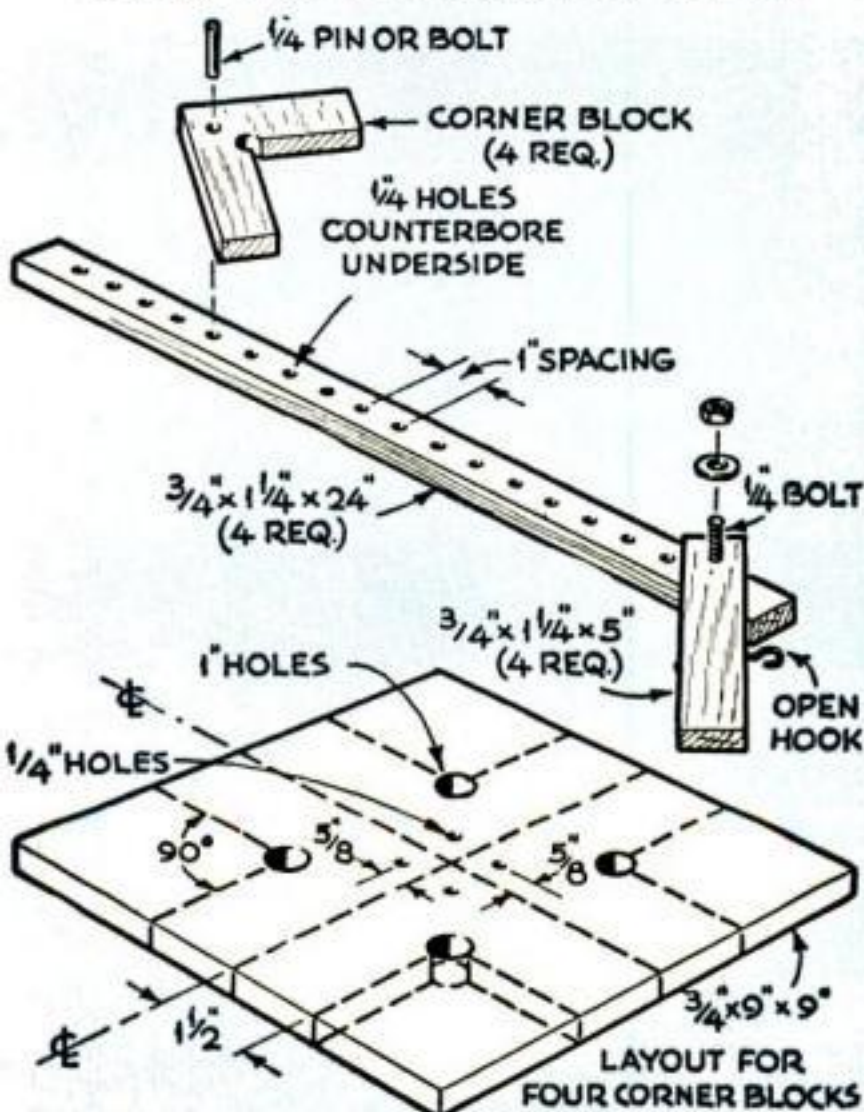


## These corner clamps make miter joining easy

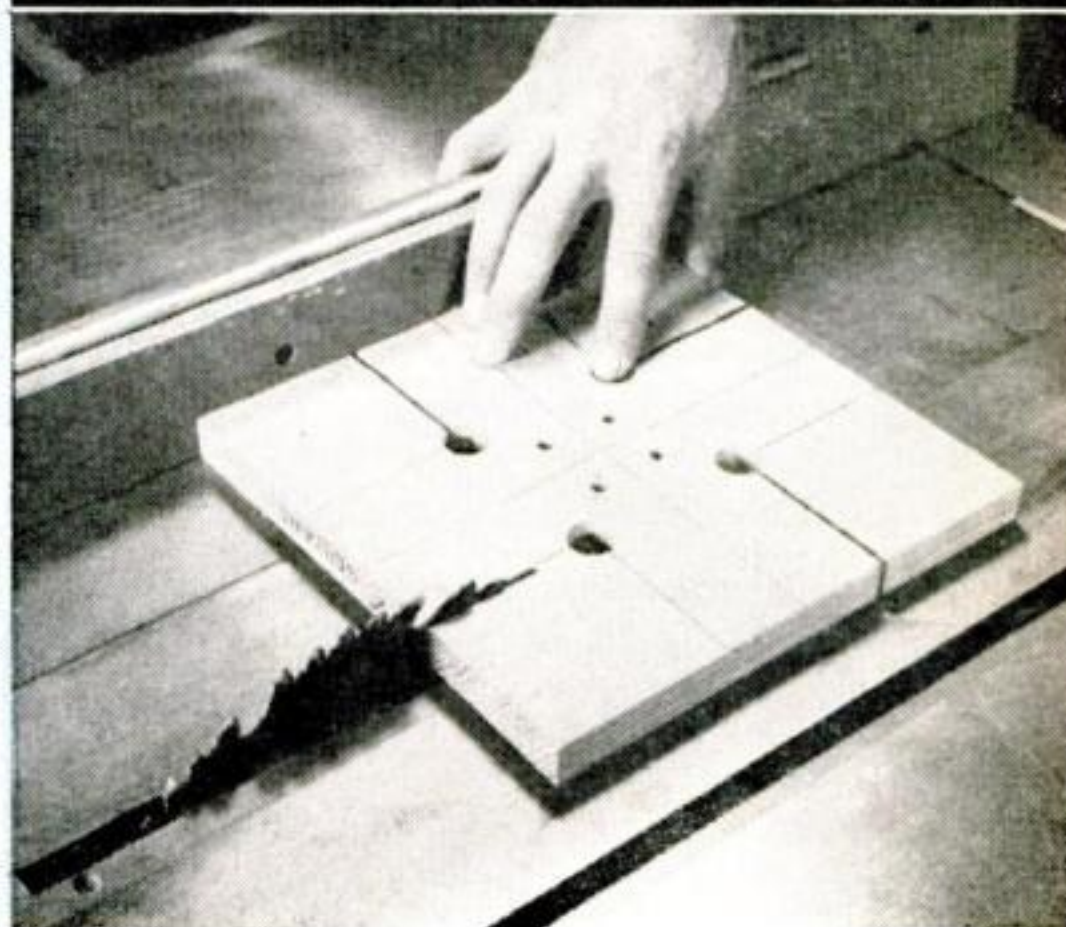
**NAILING CLAMP:** This stop-and-wedge job isn't recommended as a gluing clamp because very little pressure is exerted on the mitered ends. But it's handy for putting nailed assemblies together speedily and accurately.



**FULL PICTURE-FRAME CLAMP** is good for either square or rectangular assemblies. All corners pull together uniformly when you draw up with the turnbuckle. Inside angles of corner blocks must be a perfect 90 degrees.



**TO CUT THE CORNER BLOCKS** for the picture-frame clamp above, follow the drawing detail and the photo at right. Drill holes, then cut on a table saw to make sure you get exact right angles on the important inside corners.



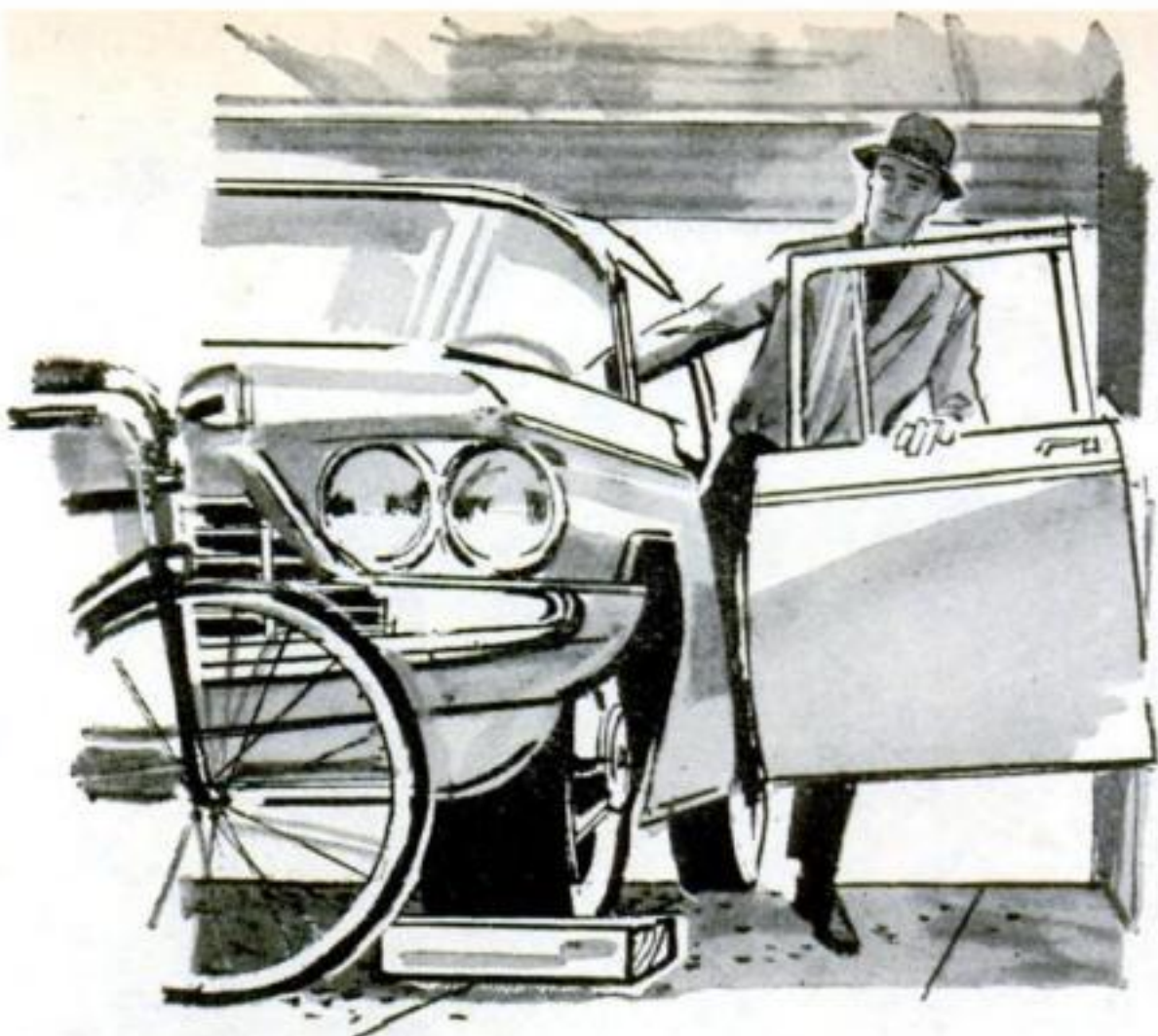


## Short Cuts and Tips

FROM PS READERS

### Contact Cement Holds Wheel Chock

I USED contact-bond cement to fasten a short length of two-by-four across one car track on the garage floor. This short chock keeps the car from bumping the end of the garage just as a long beam bolted in place would have—but was easier to install.—*Arthur Mountain, Kelseyville, Cal.*



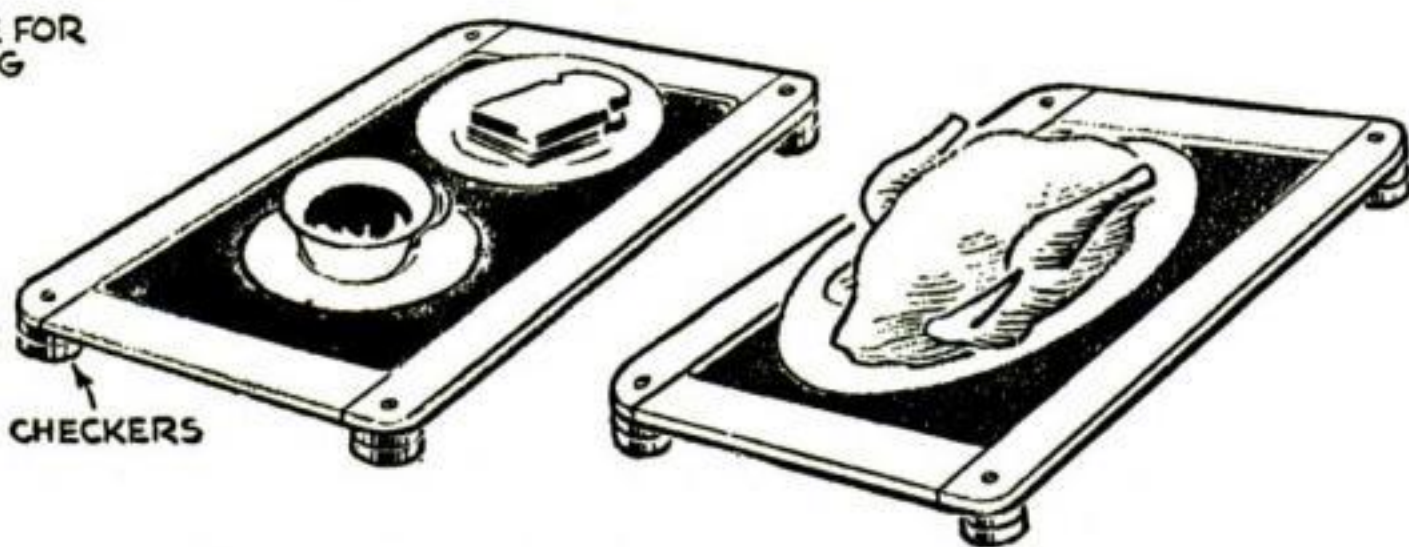
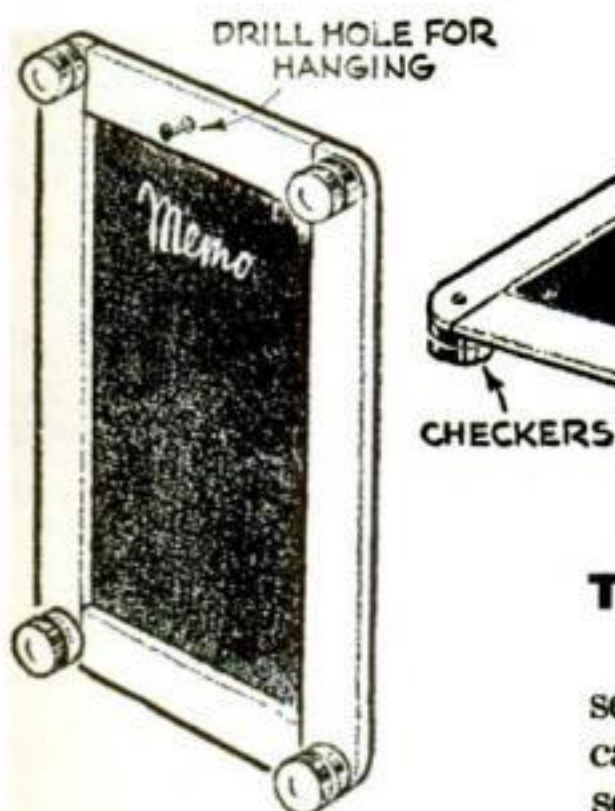
### Starting Hacksaw Cuts

NICKING smooth, hard metal with a fine mill file will make starting a hacksaw cut easier. The blade will stay in the nick and not drift on the smooth surface. Or clamp blocks of wood on each side of the mark and use them as saw guides.—*Glen F. Stillwell, Manhattan Beach, Cal.*



### Easy Cooling for Developer

BEFORE a darkroom printing session comes up, place a glass of water in your freezer section and let it freeze solid. Then set the glass in the solution and leave it until you get the right temperature. This saves fussing with ice cubes.—*Wayne Floyd, Fayetteville, Tenn.*

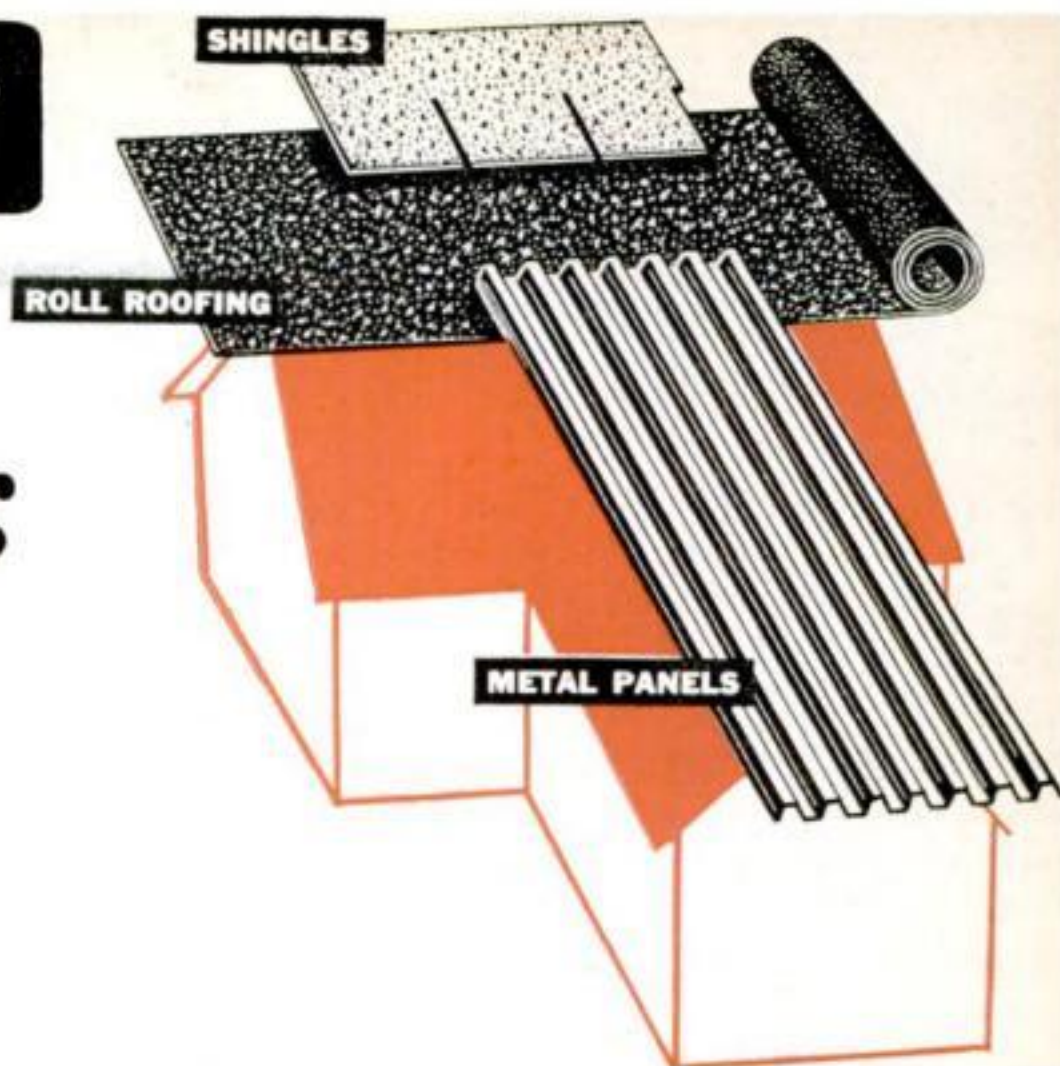


### Three Uses for One Slate

TRAY, trivet, and memo board—one slate blackboard serves as all three. Small slates—about 9" by 12"—can be purchased cheaply at variety stores. Glue or screw two checkers at each corner as legs.—*F. Shore, NYC.*



# Which Roofing Should You Buy?



**T**HE cost of a quality roof is only a little more than that of an economy type. Yet most people are so price-conscious that roofers seldom try to sell any but the cheapest kind.

Choosing the right roof is especially important today because more homes than ever need new roofs. The big post-war building boom in the late Forties produced hundreds of thousands of homes with low-cost roofs designed to last only 10 to 15 years. Now, a decade later, time is running out for these roofs.

There is a wide variety of roofing materials, styles, and colors to choose from. You should weigh all considerations carefully before you buy.

**How steep is the roof?** The slope of a roof directly affects your selection of roofing, so it's important that you know the exact pitch. You can determine this by the method shown in one of the sketches or by the use of pitch cards supplied by many roofing manufacturers.

You can use most kinds of roofing if your pitch is at least 4-in-12. This means a rise of 4" on the vertical for every 12" on the horizontal. For a low-slope roof with a pitch from 2-in-12 to 4-in-12, special installation techniques are required if you want to use shingles. Otherwise, you can use roll roofing. If your roof slope is less than 2-in-12, you will be limited to roll roofing or built-up roofing.

Asphalt roofing is by far the biggest seller of all materials, claiming 85 per-

cent of the market. It consists of three types: saturated felts, roll roofing, and shingles.

**Saturated felts** are the basis of built-up roofing. "Built-up" means just that—the roof is built up, on the job, of layers, or plies, of saturated felt, with a binding layer of bitumen (asphalt or coal tar) between felt layers. The top surface consists of gravel, slag, marble chips, or roof coating.

A built-up roof can be put on any slope, but is especially good for shallow roofs, and is the only type that can be used on a flat roof. Since its installation requires special equipment and know-how, it's best to have the job done by a roofing contractor who specializes in this kind of work.

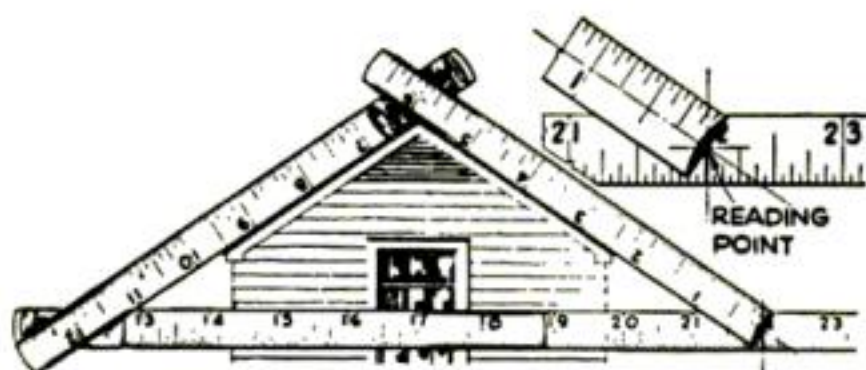
The key to a good job is the number of plies of felt you get. Many people get a two- or three-ply job, which lasts only five to ten years. But pay a little more in the beginning, and you can get a four- or five-ply roof—good for 15 to 20 years. Also, the slag or gravel used on top should meet a screen size of  $\frac{1}{4}$ " to  $\frac{5}{8}$ ". Smaller stuff is easily washed or blown away.

Installed costs for a three-ply roof on a new house range from \$12 to \$20 a square. A "square" is a common roofing term meaning 100 square feet of roof area. Each additional ply costs about 25 percent more than the basic three-ply job.


**Asphalt roll roofing** is one of the least



## A quick way to find the pitch of your roof



**FORM A TRIANGLE** with a carpenter's folding rule so that it matches the shape of your roof as you sight through the triangle. Stand as far back as possible to minimize errors, and be sure

													
RULE READING	20 $\frac{1}{2}$	20 $\frac{7}{8}$	21 $\frac{1}{2}$	21 $\frac{5}{8}$	22	22 $\frac{1}{2}$	22 $\frac{3}{4}$	23 $\frac{1}{4}$	23 $\frac{3}{8}$	23 $\frac{5}{8}$	23 $\frac{7}{8}$	24	
RISE-INCHES PER FT.	12	11	10	9	8	7	6	5	4	3	2	1	

the base of the rule is held level. Take a reading where the first section of the rule intersects the base and use the table above to find what this equals in inches of roof rise.

expensive of all roofing materials. It is made of asphalt-saturated felt with a tough coating of asphalt. You can get it smooth or with a surface of imbedded granules, in which case it is called mineralized roll roofing.

Roll roofing properly installed will give eight to ten years of service and perhaps more on steep slopes. The smooth type, while not as pleasing looking as the mineral-surfaced kind, can be recoated with asphalt every few years to give it an indefinite life.

While roll roofing can be used on any slope, it is at its best on low slopes of 3-in-12 down to 1-in-12. It comes 36" wide in long rolls equalling one square, or 100 square feet of coverage. The rolls are easy to unwind and apply on a roof. You normally lay the roll across the roof, each layer overlapping the one below it by 2" to 4".

Double-coverage, or half-lap, roll roofing is a special type designed for very-low-pitch roofs. It is half smooth on one edge and half granule-surfaced on the opposite edge, and is overlapped in such a way that you get a double layer of roofing for extra protection.

**Asphalt shingles** are surfaced with mineral granules in the same way as roll roofing, but there are many more weights, styles, and colors. The most popular shingles are the three-tab, square-tab type often referred to as "thick butts" or "3-in-1s." These shingles commonly come in strips 36" long and 12" wide.

The most widely sold of all asphalt shingles are the standard grade, which weigh about 210 to 215 pounds per square. Square-tab shingles are available, too, in heavier weights of 250, 275, 290, 300, and 325 pounds per square.

**Watch out for wind damage.** Next to the sun, wind is the biggest enemy of asphalt shingles. The tabs lift in high winds, cracking the asphalt and dislodging the surface granules. To keep this from happening, especially on low-pitch roofs, it is recommended that the shingles be gently raised and a small dab of asphalt cement the size of a 50-cent piece be placed under each tab with a caulking gun or trowel to seal down the edges of the shingles. Be sure that the cement is placed far enough back from the edge so it can't squeeze out and mar the appearance of the roof.

Even without wind, asphalt shingles curl up every night as the top surface cools off and contracts, causing them to bend upward. In the morning, they warm up again and flatten out. This constant flexing of the shingles every day causes the granule surface to flake off.

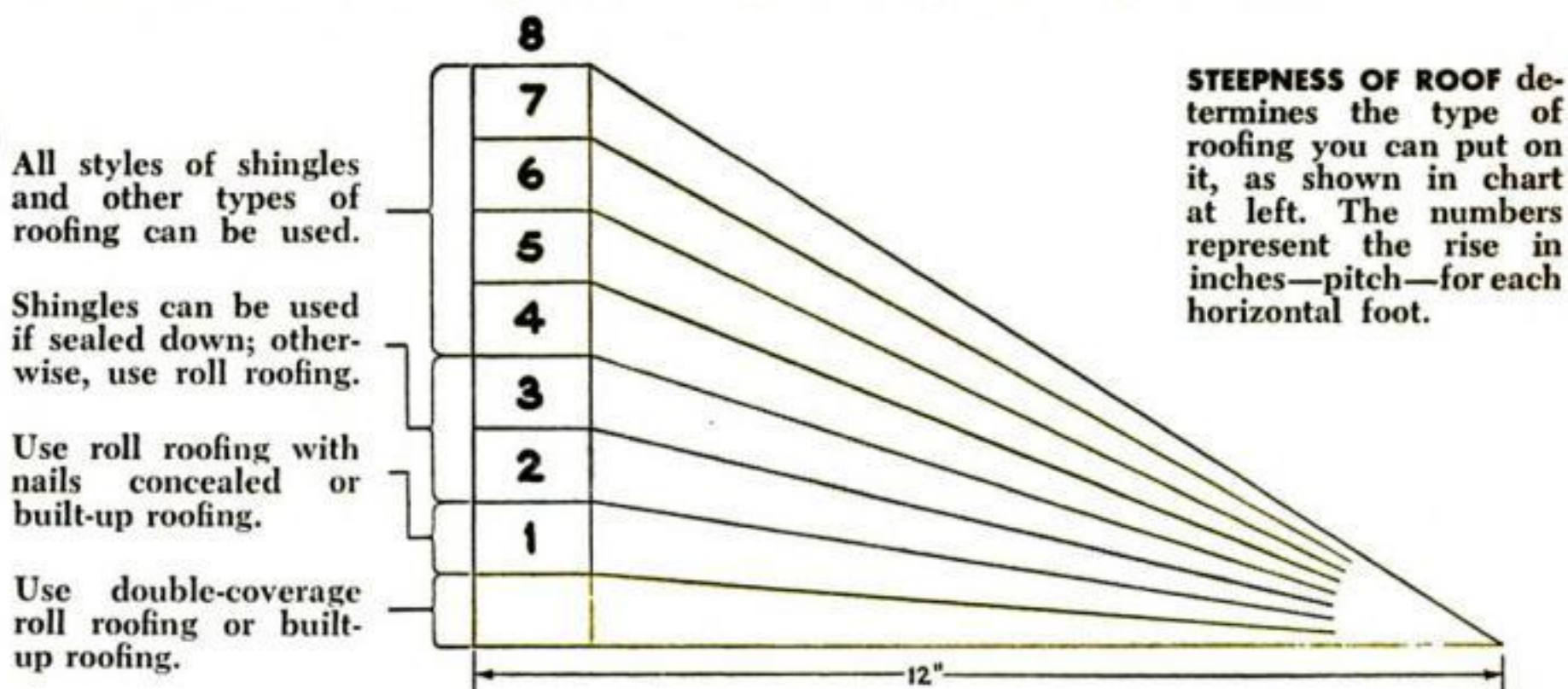
**How long will they last?** Shingle life is based on how long they will keep their surface granules, not necessarily on how long they will keep the rain out. At the point when the granules start to go, the roof loses color, ugly dark patches appear, and most people insist on reroofing immediately even though the roof will stay watertight for several more years.

The standard-weight 210-215-pound shingles will keep their surface granules for about 15 years, a little less in the south where the sun is hotter, often more in the cooler north. Heavier-weight shingles will keep the rain out longer, but many experts argue that they will lose their surface granules at about the same time as the standard weight and thus have the same "practical" life.

Two newer shingles that have become popular in recent years are self-sealing



## How to choose roofing according to the pitch of your roof



and interlocking types that are designed to prolong shingle life by preventing them from curling. The self-sealing kind comes with a factory-applied adhesive on the underside of the tabs. The heat from the sun softens the adhesive, sealing the tabs in place.

Interlocking shingles are available in a number of styles and are arranged so that their edges lock or lap together. This way, each shingle helps to hold the next one down so it can't curl from contraction or lift in the wind.

If you choose an asphalt roof and want to be sure of a good job, get a copy of the industry's highly regarded application manual. It's available for 40 cents from the Asphalt Roofing Industry Bureau, 50 E. 42nd St., New York 17, N. Y.

**What about cost?** Asphalt shingles vary widely in cost depending on shipping distances and market conditions. Here are average uninstalled prices recently quoted in one medium-size town: Regular 210-215-pound grade, \$8.50 a square; 210-215-pound self-sealing or interlocking, \$9 to \$10.50; 250-pound, \$11.25; 300-pound or heavier, \$13.50 to \$16.

On a typical house with 1,500 square feet of roof requiring 15 squares of shingles, that means you can buy a self-sealing or interlocking roof for an average of \$18 more than a regular roof. Since labor costs run about the same for all types of roofing, you pay very little more to have a top-quality roof than a less-expensive one.

**Wood shingles and shakes** are generally considered the next step up in



**SEALING DOWN THE TABS** of shingles is good protection against rain and wind damage regardless of roof slope. It also makes possible the use of shingles on pitches as low as 2".



**THE ROOF STAYED ON** even though the house blew down—a remarkable example of the strength of interlocking shingles. They hook together so each one helps to hold the others down.

quality and price after asphalt. A wood roof will give you a handsome natural finish, and it is strong, durable, and highly wind-resistant.

The most common are red-cedar shingles, about  $\frac{3}{8}$ " thick and 16", 18", and 24" long. They will last 20 to 35 years or more depending on the grade you buy



and the pitch of your roof. "Brush on an oil-base stain every five or six years," one expert says, "and they will last forever." It is the wetting by rain and drying by sun that causes wear.

The Red Cedar Shingle Bureau, which represents many makers, has established three grades of wood shingles. Certigrade No. 1 Blue Label is a top-quality, fine-grain shingle selected especially for use on roofs where shingles must lie flat and tight. Certigrade Red Label is less expensive and is designed primarily for side walls that are subject to less wear than roofs. Certigrade No. 3 Black Label is an economy shingle for side walls, farm buildings, or undercoursing under other shingles.

Besides wood shingles, there are also shakes. These are made from the same wood as shingles but are largely hand-split rather than machine-sawed. The result is a rough, rustic texture.

Shakes range from 18" to 32" long and up to 14" wide. You have a choice of three grades: 1) barn shakes about  $\frac{3}{8}$ " thick; 2) taper-split  $\frac{1}{2}$ " to  $\frac{5}{8}$ " thick; and 3) the super-deluxe heavy shake  $\frac{3}{4}$ " to  $1\frac{1}{4}$ " thick. The thicker the shake, the higher the price and the longer it lasts. A shake roof should last from about 30 years for the thinnest barn shakes, up to 50 to 75 years or more for the heavy shakes.

Cost of a wood roof starts at about \$20 a square for cedar shingles up to \$32 or more a square for heavy shakes, depending on freight costs.

**Asbestos-cement shingles** are gaining in popularity since they are tough, fire-proof, and long-wearing. Experience to date suggests that they will last at least 40 to 50 years. They are available in many colors and are good-looking, although it is hard to tell the difference between them and top-quality asphalt shingles.

Asbestos-cement roofing should be given care during application and the installer should not subject it to any unusual shocks, as it may crack. By wearing soft shoes or sneakers and using a little care, there is little to fear in walking on this roof.

The installed cost of asbestos-cement roofing ranges from about \$30 to \$40 a square.

**Ceramic tile and slate** are the king and

queen of roofing materials in quality and price. Both will last for many generations. Most people associate a tile roof with the oval-shaped, orange-colored tiles seen on Spanish-style or California Mission houses.

More common today are thick, flat tiles that give a handsome appearance. But you should insist on a "hard-burned" tile. When tapped with a coin it will ring out with a clear tone. Watch out for the cheaper, soft-burned tile which is poorer in quality and will not last as long. Hit with a coin, it will give off a dull thud.

Like tile, slate also offers a handsome, substantial appearance. But because of its weight and cost, it is usually used only within convenient shipping distances of slate quarries, such as in Pennsylvania, Virginia, and Vermont.

Like asbestos, both tile and slate are brittle. A misplaced step or stray home-run ball can crack them. Freezing rain in winter also can mean occasional broken shingles to be replaced. Costs start at about \$50 to \$75 a square.

**What about aluminum?** The big news in aluminum is the recent introduction of new kinds of aluminum shingles and sheet aluminum especially designed for houses. Although first cost is high, your long-term cost may drop below lower-first-cost materials, since an aluminum roof should last "indefinitely," according to big manufacturers such as Reynolds and Alcoa.

Other advantages are low maintenance, light weight (a mere 30 to 40 pounds per square), easy installation, and high heat reflectivity, giving you a cooler house in summer than with other roofs. Various colors are available.

But with an aluminum roof you should make doubly sure that the whole house is well grounded to the earth for lightning protection. When an existing house is reroofed with aluminum, also make sure that the new aluminum does not come in contact with old galvanized-iron nails or flashing. Otherwise, electrolytic corrosion can start between the two dissimilar metals. This normally requires that the old roofing be stripped away when you reroof with aluminum.

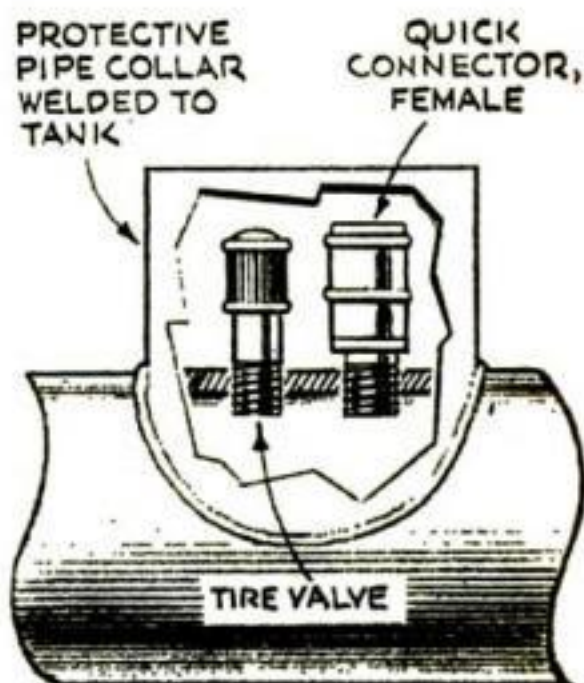
Installed costs of aluminum range from about \$30 to \$40 a square for sheets to about \$45 to \$60 for shingles.





## Short Cuts and Tips

FROM PS READERS



### How I Carry Spare Air in My Truck Bumper

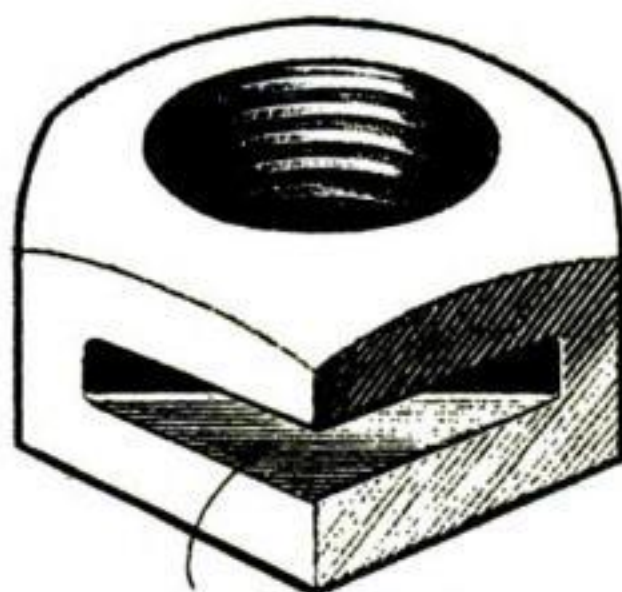
PRESSURIZED air that I carry in a bumper on my truck enables me to get to a service station if a tire develops a leak or gets soft. I replaced the conventional bumper with a length of 4" pipe, capped at both ends. It is attached to the truck by two smaller stub pipes, saddle-fitted and welded, with the free ends flattened to fit the frame. In the center of the big

pipe, I welded a protective collar, open at the rear. Inside this cup are threaded a tire valve for air-filling, and a quick-connector (female). To complete the rig, I carry a hose long enough to reach all tires, with a quick-connector (male) at one end and a tire chuck at the other. The air is there when I need it.—George A. Healy, Hemet, Calif.



### Direction Marks on Wrenches

WHEN picking up a ratchet wrench there is no way of knowing in which direction the ratchet is locked. I solved the problem by painting an L or an R at each end on the appropriate sides of my wrenches. Now I know which side to put on a nut. With L showing, I turn counter-clockwise; with R showing, clockwise.—Karl J. Krausse, Rockville, Md.



HACKSAW CUT

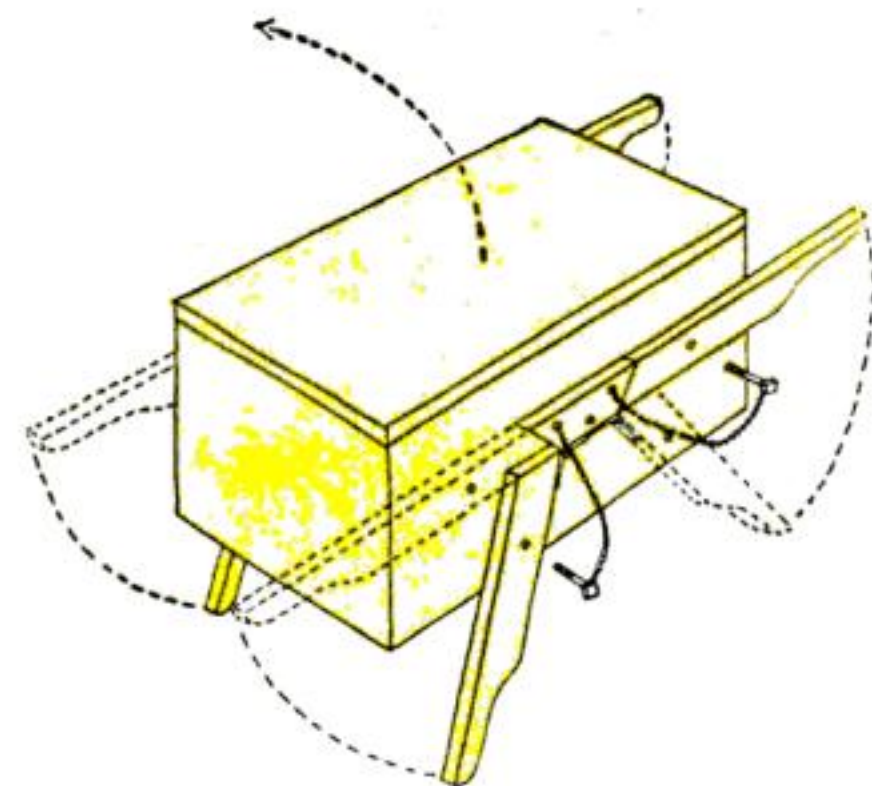
### Slot Makes a Nut Lock

A LOCK washer of the proper size is seldom handy when needed. Cutting with a hacksaw through one angle of a hex nut, near the outside face, will serve the same purpose. Partially close the slot with a light hammer blow to depitch the threads. When the nut is forced on a bolt the compressive force makes it impossible for jars to loosen it.—Daniel Bousha, Jackson, Mich.

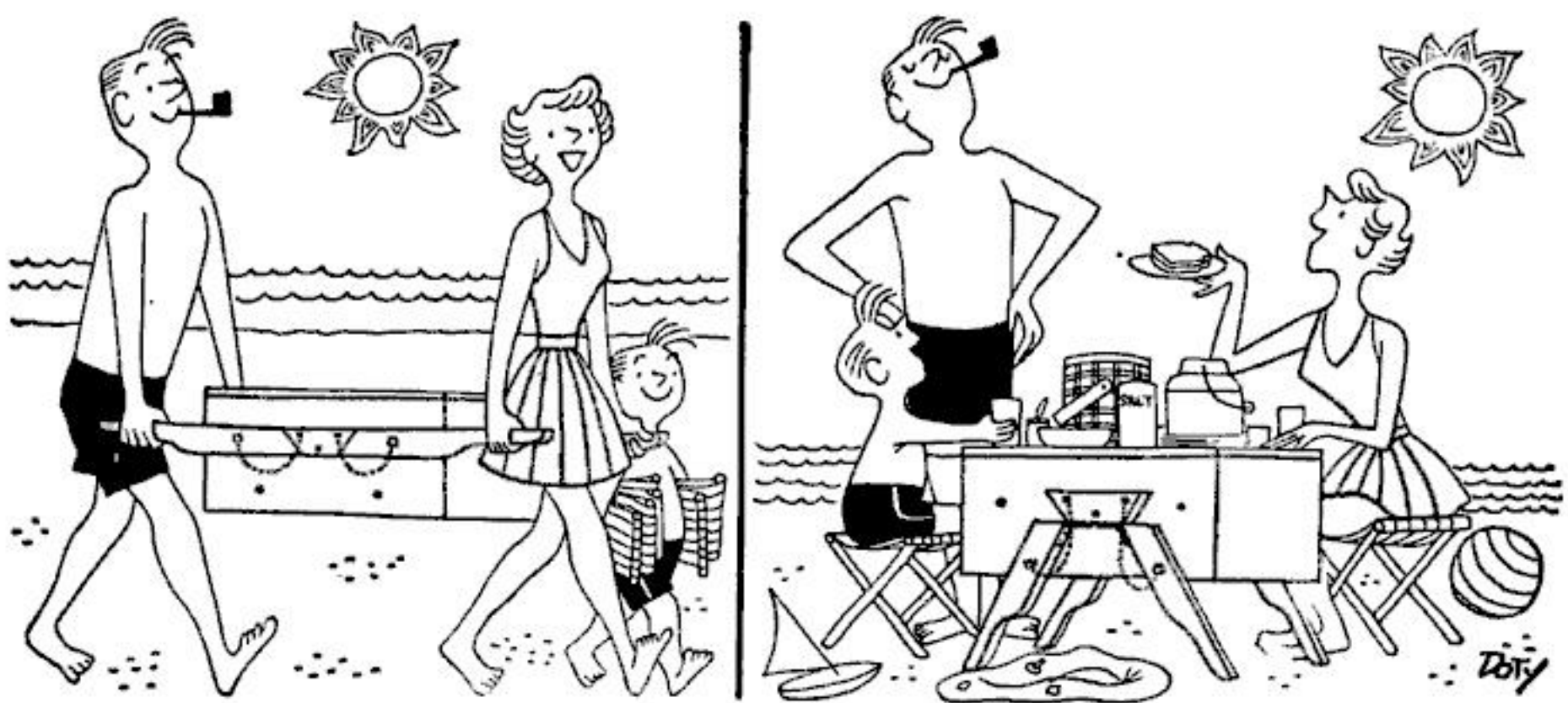
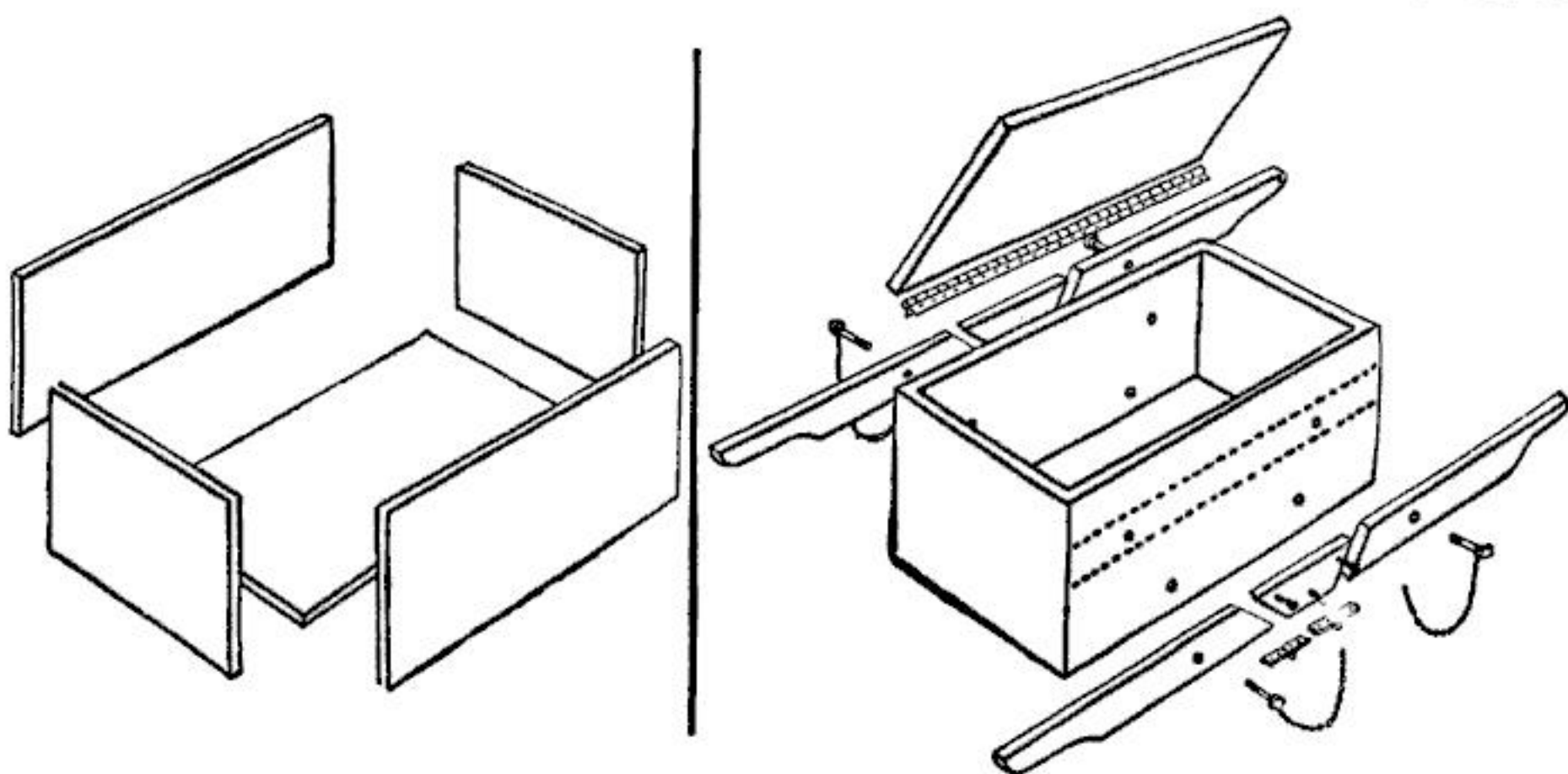
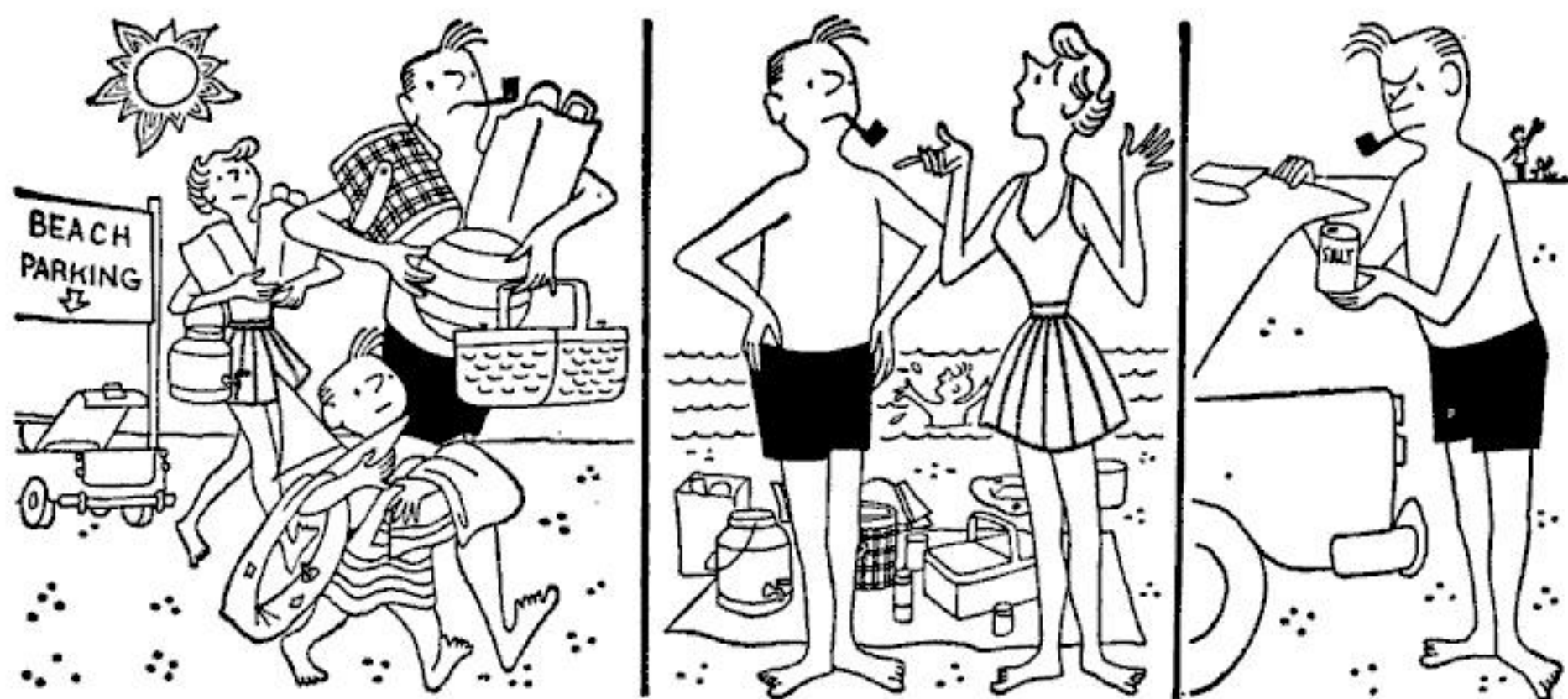


# Wordless Workshop

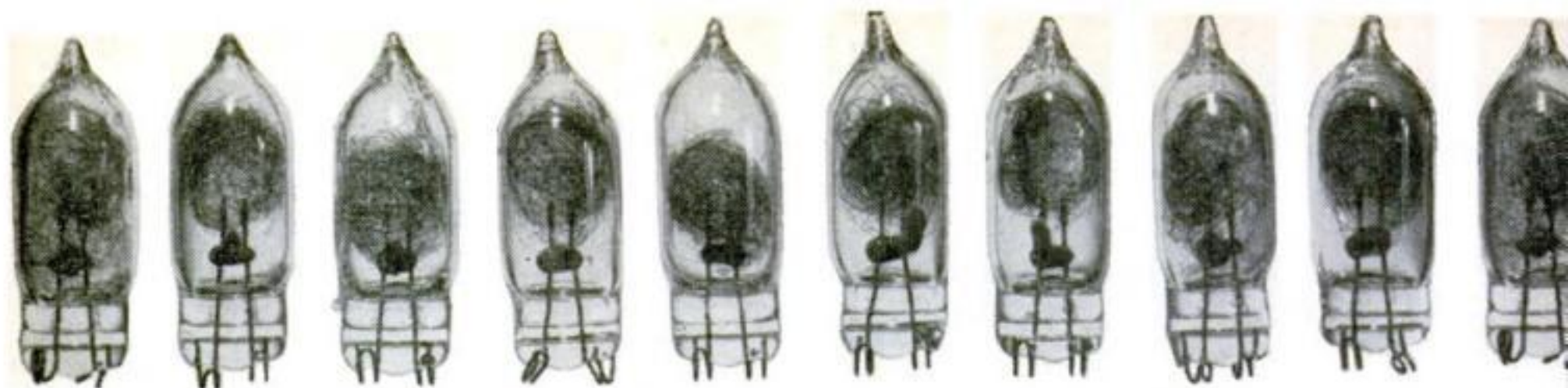
By Roy Doty  
and Roy McGuckin







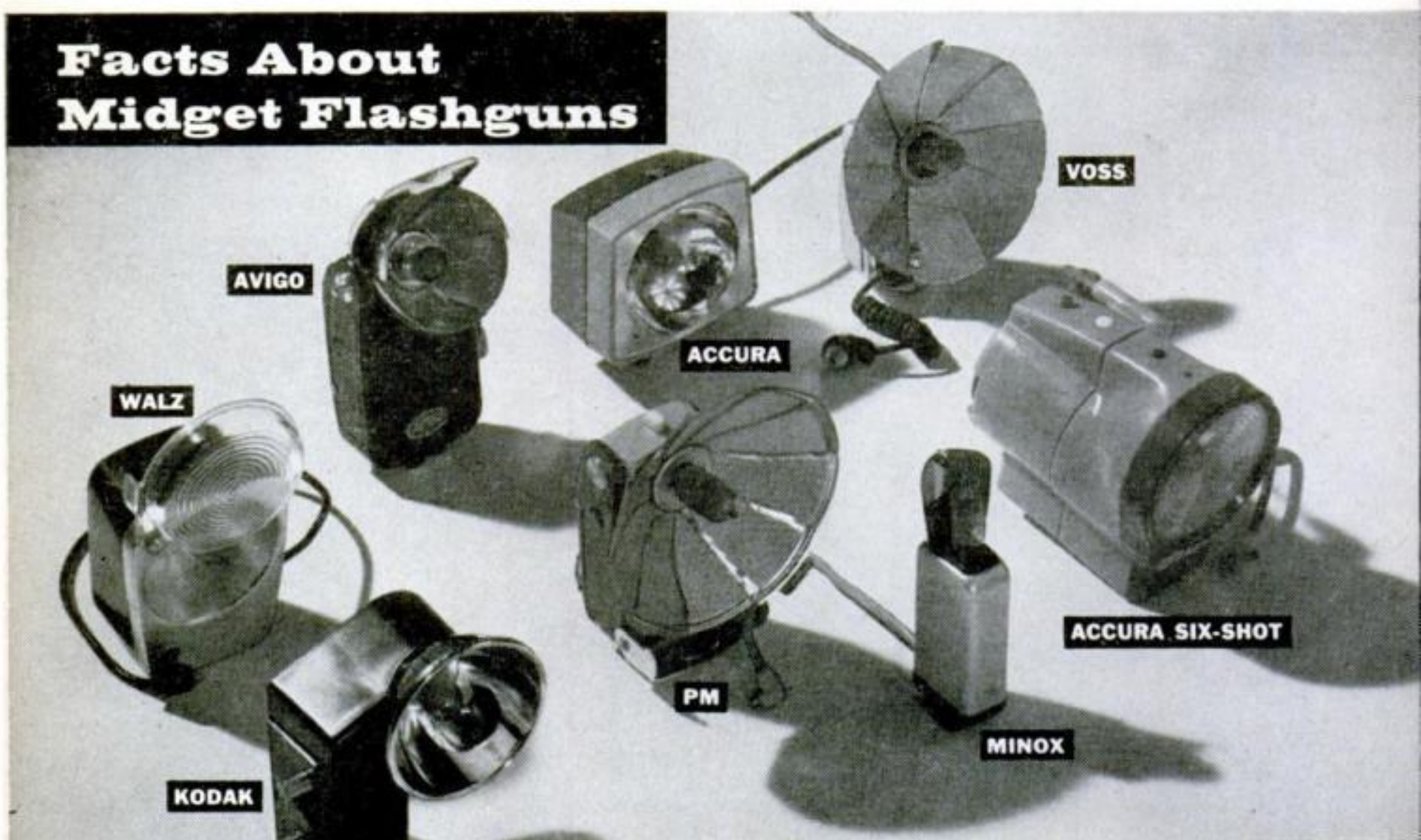




# Why Flashbulbs

*A powerful new midget bulb and vest-pocket flashguns*

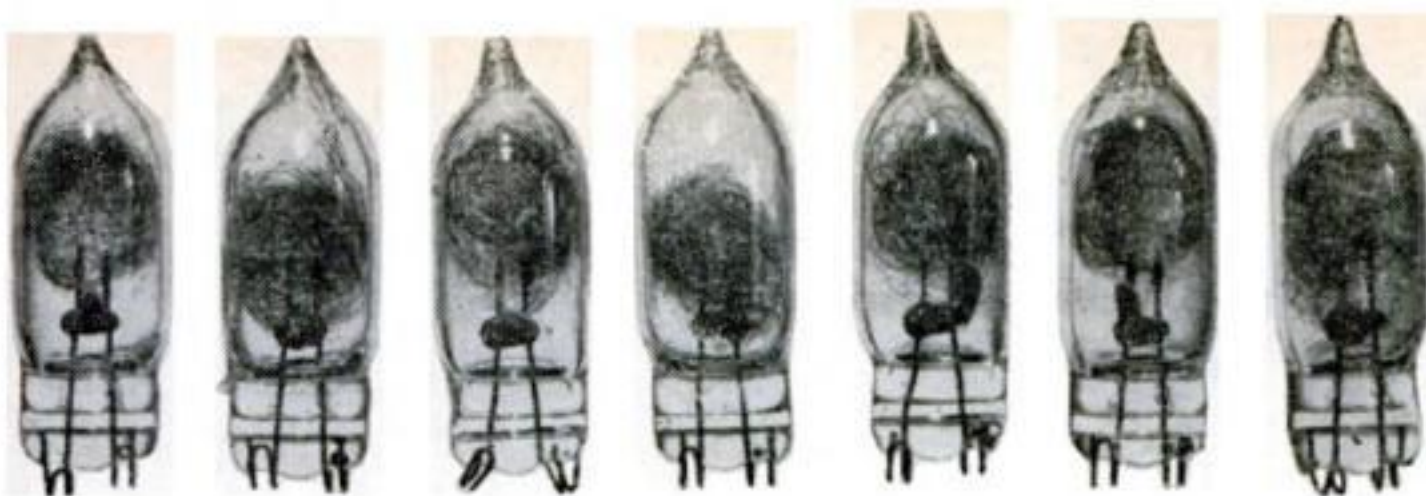
## Facts About Midget Flashguns



MAKE AND MODEL	APPROX. PRICE	SIZE (inches)	BATTERY	REFLECTOR	TEST LAMP	EXPOSURE GUIDE	BULB CAPACITY	BOUNCE FLASH
ACCURA AG MODEL BC	\$4	3x2½x1½	15-v. BC	2" polished	no	dial	1	no
ACCURA AG AUTOMATIC	\$10	3½x3½x2¼	22½-v. BC	2" polished	yes	dial	6	no
AVIGO AG-1 DELUX	\$8	4x2x2	15-v. BC	2" polished pebble	yes	dial	1	yes
KODAK SUPERMITE AG-1	\$4	3x2x2	2 1½-v. AA or 15-v. BC	2" polished	no	chart	1	no
MINOX BC MODEL U	\$20	3½x1x½	15-v. BC	1" polished	no	none	1	no
PM AG-1 MULTI-BOUNCE	\$8	4½x3½x2	15-v. BC	3½" polished pebble	yes	dial	1	yes
RONDO AUTOMATIC	\$10	4½x3½x1½	15-v. BC	2" polished	yes	dial	6	no
VOSS AG-1 BOUNCE	\$6	4x3¼x2	15-v. BC	3¼" pebble	yes	chart	1	yes
WALZ BC MICRO S-1	\$4	3x2x1½	15-v. BC	2" satin	no	none	1	no

The units above represent those available at time of publication; other models will follow.





**NEW MIDGET BULBS**, shown actual size, are only  $\frac{1}{2}$ " in diameter by  $1\frac{1}{4}$ " long. Note the thin wire contacts, which must be carefully protected to prevent their bending and misfiring.

# Are Here to Stay

*are helping them to make a startling comeback*

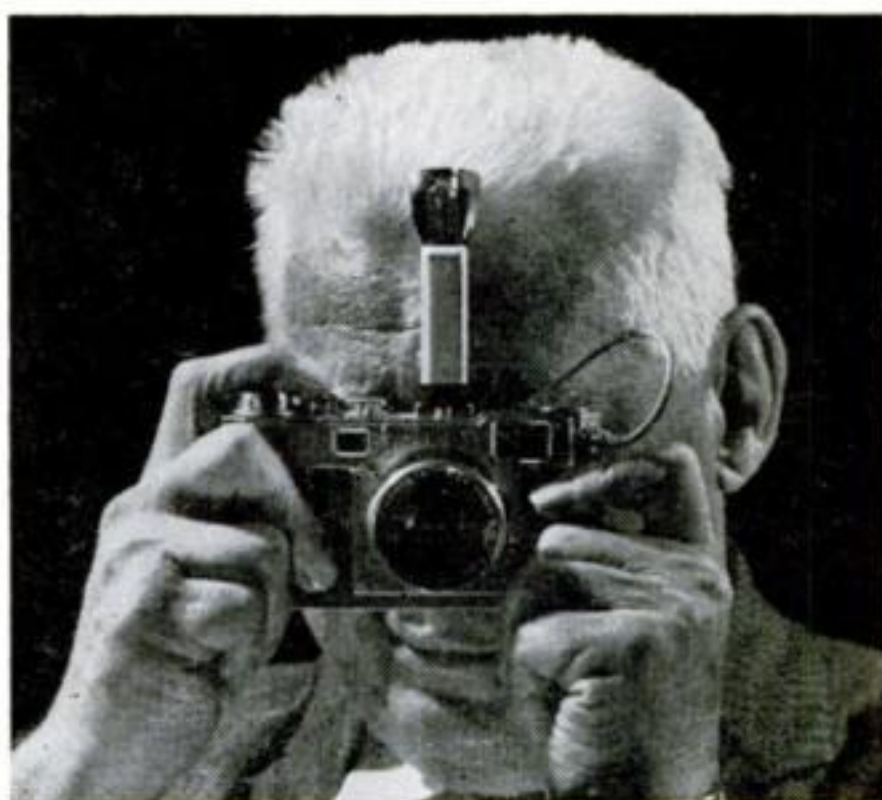
**By Myles Adler**

**W**HEN electronic flash came into use in 1946, it looked as if old-fashioned flashbulbs would soon be as dead as ancient flash powder. But now, almost 15 years later, flashbulbs are going stronger than ever.

One reason for their popularity is a brand-new bulb so tiny you can carry enough in one pocket to shoot more than 100 pictures. No bigger than a jelly bean, the AG-1 is the first flashbulb that can be used with any camera—and at any synchronization—without your having to buy special bulbs for each type.

Along with the new bulbs have come midget flashguns—some small enough to slip in a shirt pocket. Most of them have

**SIX-SHOT REPEATER** is one of the snazziest of the new flashguns. It holds six bulbs in a rotary magazine. To change bulbs, you pull out a knob on the back and turn it (below, right).



**SMALLEST FLASHGUN** is this Minox, about the size of a pack of chewing gum. The tiny 1" reflector retracts into the case when not in use so the entire unit can slip into a pocket.

This disengages the used bulb from the reflector and advances the magazine to the next new bulb. Made by Accura, it also has a dial that automatically calculates correct exposure.



CONTINUED

155





**SMALLER THAN A PACK OF CIGARETTES**, this new package holds a dozen miniature bulbs in two rows of six each. Plastic sleeves help to protect the bulbs' delicate wire contacts.



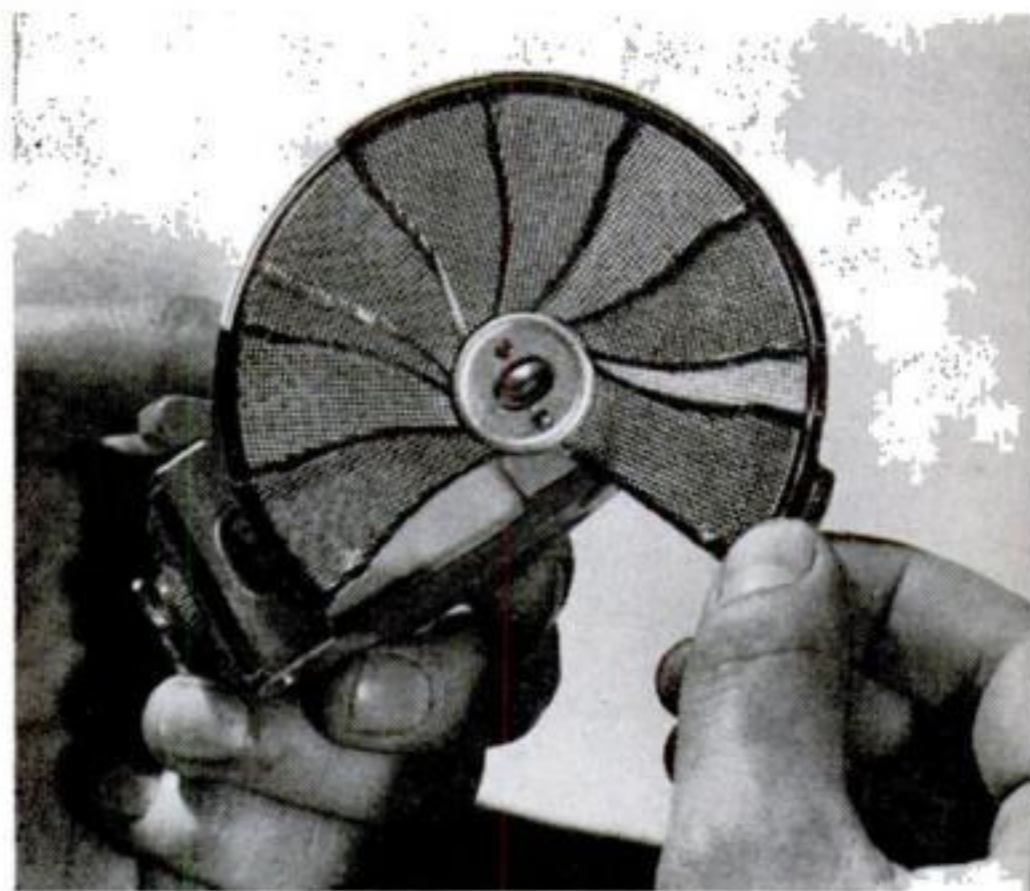
**BOUNCE LIGHTING** is made easy on several flashguns that have provision for tilting the reflector. This Voss model can be set at any angle from full horizontal to full vertical.

2" or 3" reflectors instead of the older 5" types required by larger bulbs. Some of the guns have reflectors that fold up like a lady's fan so they take practically no space when not in use. Other guns do special tricks—they tilt at various angles to permit bounce-lighting effects, or they fire up to six bulbs in rapid succession so you don't have to stop to reload.

With these new bulbs and guns, you can carry your own artificial light in the palm of your hand without the weight and cost of an electronic unit. While they aren't designed to be substitutes for electronic flash, they can do many jobs well that would normally require either flashtubes or special large-size focal-plane bulbs.

**How they work.** The AG-1 bulbs get their name from their all-glass shell. Unlike conventional flashbulbs, they have no metal base—only two wires sticking out of the bottom of the glass. The glass shell measures only  $\frac{1}{2}$ " in diameter by  $1\frac{1}{4}$ " long.

The bulbs are filled with zirconium wire and oxygen, first introduced in the M-5 and M-25 bulbs. Although only one-sixth the size of the aluminum-filled M-2 bulb, the AG-1 provides about the same amount of light. Used in a polished reflector with Plus-X film, it has a guide number of 110, giving it a range of over 50 feet at f/2 and  $\frac{1}{50}$  second. At the average photographic distance of 10 feet,



**FOLDING REFLECTORS** save space on about half of the new flashguns. The  $3\frac{1}{2}$ "-diameter disk on this PM unit collapses like a lady's folding fan into a thin sandwich about  $\frac{3}{4}$ " by 2".



this means you can stop the camera down to f/11.

The AG-1 bulbs actually provide more light than many electronic flash units. With daylight-type Kodachrome, the average portable electronic unit has a guide number of 32. The AG-1 bulb used with Type F Kodachrome at 1/50 second has a guide number of 44—which is one stop more.

Besides its power, another advantage of the bulb is that it can be used with any camera from a simple box to the complicated focal-plane type. This versatility is due to a 15-millisecond delay to peak and a relatively flat light curve similar to that produced by a No. 6 or No. 26 focal-plane flashbulb. The bulbs are synchronized for X and F settings up to 1/60 second, M at all shutter speeds, and focal-plane cameras up to 1/1,250 second. At 1/1,250 second, the Plus-X guide number drops to about 24.

**Blue bulbs for color.** The new bulbs also come in a blue tint, for use with daylight color film. These blue bulbs, called AG-1B, have the same characteristics as the clear AG-1s except that they provide one less stop of light. They should be used with daylight color film both indoors and out. The clear bulbs are used with indoor color film.

Both bulbs are now being made by three major manufacturers—General Electric, Sylvania, and Westinghouse. They are

all similar in power and performance. They come in packages of a dozen for about \$1.32 for the clear type and \$1.56 for the blue. Prices are expected to drop as production goes up.

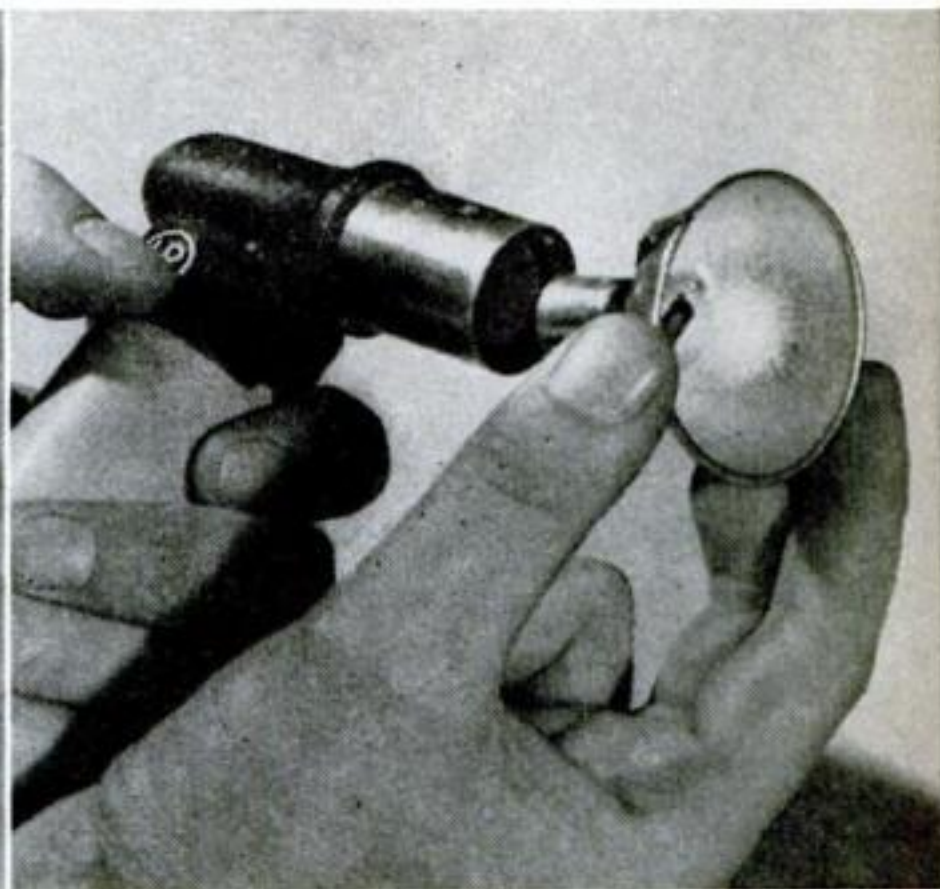
On the back of each package are the guide numbers for the most popular films. General Electric publishes a very useful booklet called "GE Photolamp and Lighting Data," available for a dime at photo stores. It contains complete information on the use of the new AG-1 and AG-1B bulbs at all shutter speeds and film ratings, as well as a separate chart for use with focal-plane cameras.

**Miniature flashguns.** Since the new bulbs were introduced, manufacturers have been racing to bring out midget flashguns designed especially for them. Most models have either a rotating guide-number dial or a chart on the back for making fast exposure calculations. These are a definite aid, though not an absolute necessity since you can find the exposure by dividing the guide number by the lens-to-subject distance. When using a focal-plane camera, you generally open up one extra stop.

About half the new flashguns have a test lamp to check ahead of time whether the bulb will fire. This is important to look for since the wire contacts on the bulbs are very delicate and, if slightly bent, may keep the flashgun from firing. In fact, many of the various units tested



**MINIATURE BATTERY**, used with a capacitor, packs a hefty wallop, eliminating bulky old-style power supplies. This Walz gun sports a retractable flash shield over the reflector.



**TINY ADAPTOR** permits the new baseless bulbs to be used in standard flashguns having a No. 5 bayonet socket. This Walz model has its own built-in 2" reflector, costs about \$2.



failed to fire solely for this reason. Those units equipped with test lights gave forewarning, of course. The Kodak gun, incidentally, while it has no test lamp, consistently fired even bulbs that had badly mutilated contacts.

**Points to check.** Be sure that the bulbs are gripped firmly in the socket. A few of the units tested held the bulbs so loosely that they fell out. Another possible weak spot is the mounting shoe that fits into the accessory clip provided on most cameras. Some of the shoes did not fit snugly enough and slipped out. In gen-



**NEW CAMERAS**, designed especially to take the AG bulbs, are also coming on the market. This Kodak Brownie Starmite has a built-in 2" reflector and power supply, weighs eight ounces.

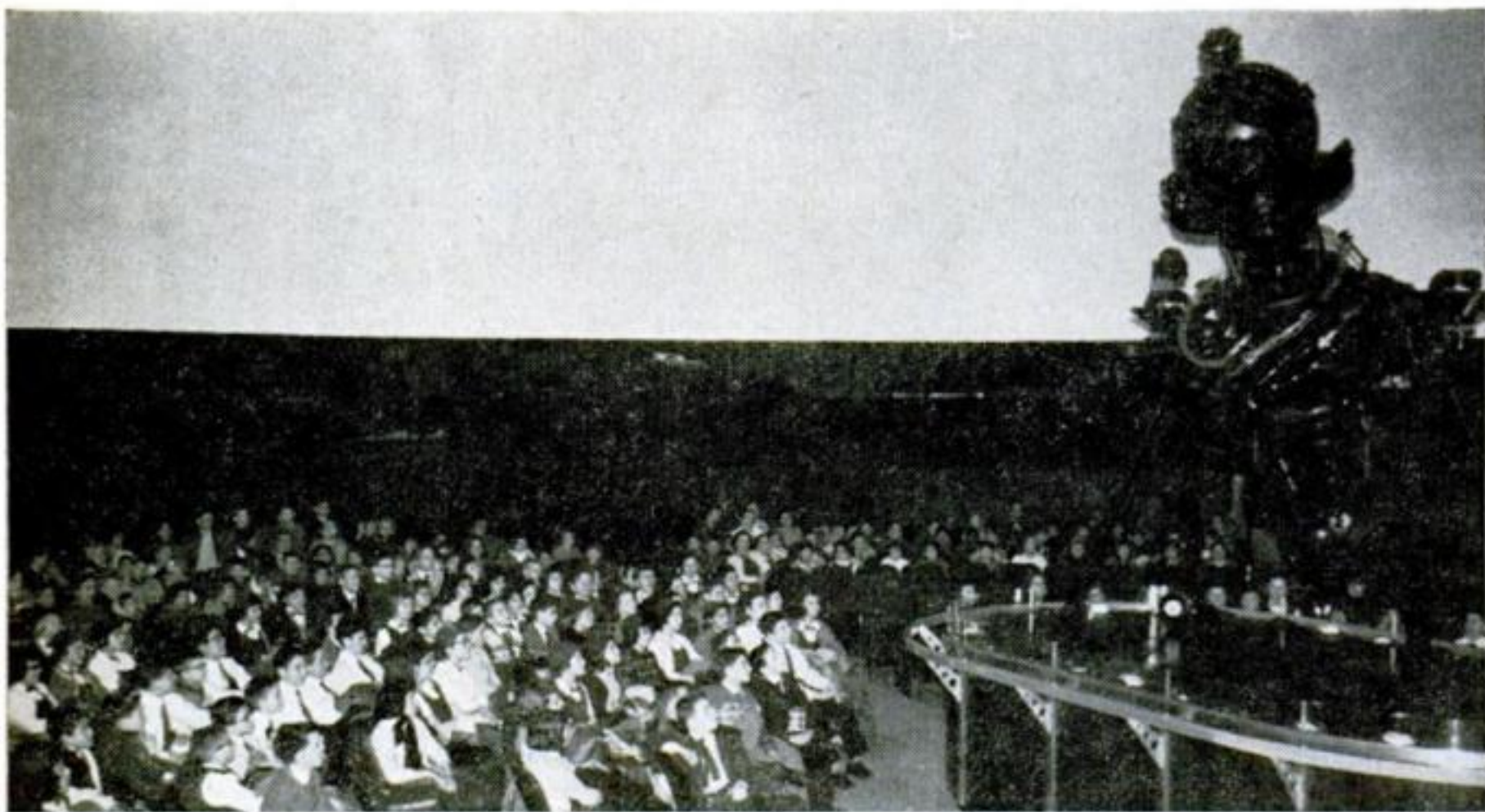
eral, guns with a locking nut on the shoe proved to be the most secure.

On cameras not equipped with an accessory clip, you'll need an adaptor bracket to attach the gun. The Kodak model has its own special screw mount to fit Kodak cameras, but with another type of adaptor bracket it can be used with any camera.

As yet, none of the guns provides an extension socket for multiple or off-camera flash, which may prove a disadvantage for advanced photography. Two or more guns could be hooked up to fire simultaneously, but you'd have to figure out your own wiring. Also, adaptor sockets are available for those who prefer to use the new bulbs in standard flashguns for greater flexibility.

All of the new guns have a battery-capacitor ignition system, using either 22½- or 15-volt batteries. The capacitor builds up and holds the charge that actually fires the bulb. This enables a very small battery to provide consistently uniform pulses, even when it starts to run down. Guns having satin or pebbled reflectors require a lens opening ½ stop larger than those having polished reflectors.

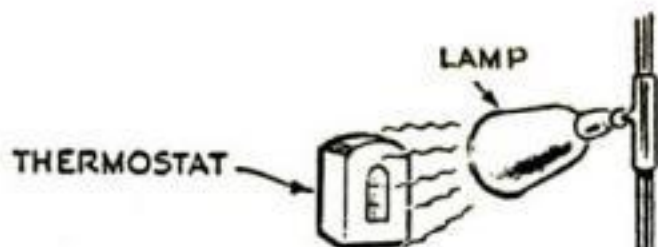
One of the biggest advantages of the midget units is their reasonable price. You can get one for as little as \$3.95. Even the most expensive is only \$20.



**A SINGLE FLASHBULB** provided sufficient light for this interior shot of New York's giant Hayden

Planetarium, proving that the tiny new bulbs have plenty of power and distance.





## A "Rube Goldberg" Automatic Thermostat

I GET the advantages of a costly automatic thermostat at no expense by hooking up a floor lamp to a clock timer. At bedtime, I move the lamp close to the wall thermostat. The heat from the bulb keeps the reading high during the night even though the room cools off. At six a. m. the timer turns the lamp off, the reading drops, and the furnace promptly turns on.—*S. N. Stresnic, Ft. Lauderdale, Fla.*

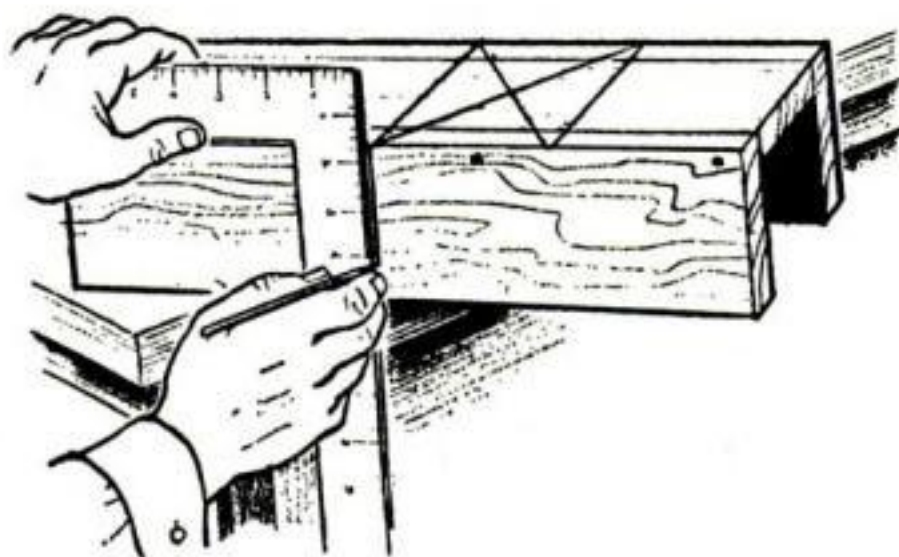


## Short Cuts and Tips

FROM PS READERS

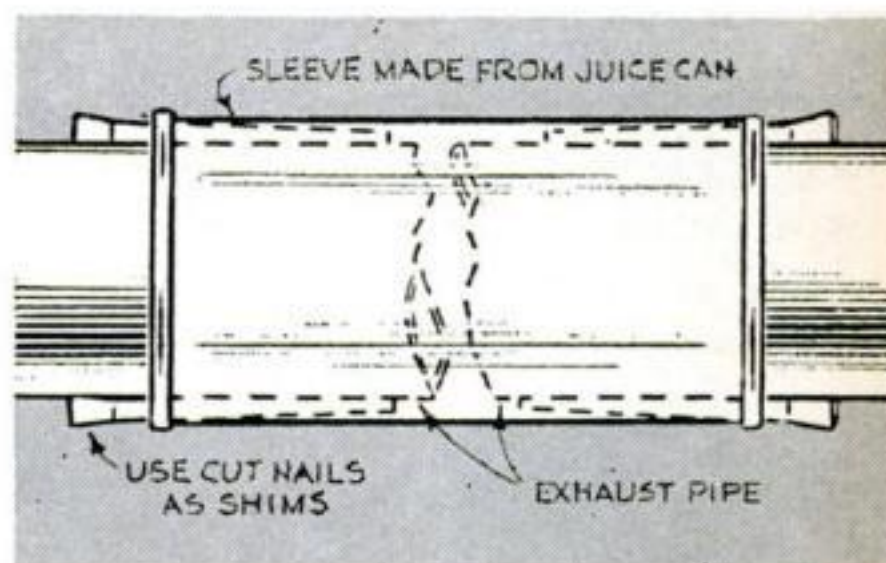
▶▶▶ A HOUSEHOLD knee pad of sponge rubber can be cut to fit inside the bottom of a tool box. The cushioning will protect your tools—especially those with cutting edges.—*S. Fleischman, Flushing, N. Y.*

▶▶▶ COLD weather makes putty and glazing compound hard to work, but I have found that they become pliable when heated for a few minutes on an electric iron.—*Clarence E. Boundy, Elgin, Ill.*



## Laying Out Miter-Box Slots

AFTER assembling a miter box, you can be certain of accurate 45-degree sawing slots if you lay out an exact square across the bottom as shown above. Carry these guide lines up the sides to the top edges of the box, using a square. Make two diagonal saw cuts between these lines.—*Daniel Bousha, Jackson, Mich.*



## Repairing an Exhaust Pipe

QUICK temporary repair of a broken auto exhaust pipe can be made with a frozen-juice can. Cut out both ends and slip the resulting sleeve over one of the broken ends. Realign the pipe and slide the can back to cover the break. Hold it in place with cut nails inserted as shims.—*Carlton G. Bucher, White Plains, N. Y.*

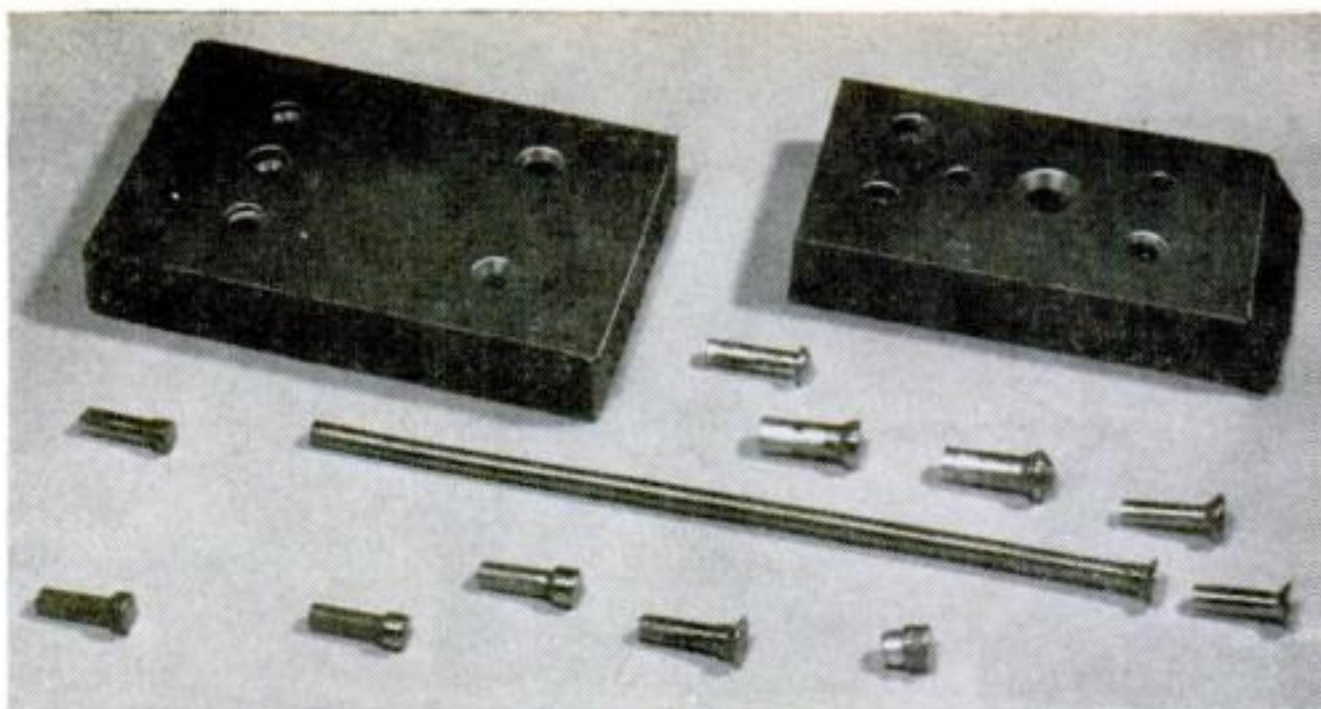
## Handle for Chalk Stubs

A MATH instructor I know finds it easier to use short pieces of chalk if they are forced into a cigarette holder. Chalk is slightly larger than a holder but can be scraped slightly to make it fit.—*Carl Miller, Detroit.*





# One MACHINIST tells another...



**HOMEMADE DIE BLOCKS** with brass, aluminum, and steel parts formed in them. Many parts can be quickly duplicated.

## ...Cold Forming Saves Time

**O**FTEN the quickest and easiest way to form small machine parts, fasteners, or model parts is by cold forming.

Suppose you need an odd-size pin or rivet having a flat, countersunk head. Use a block of tool steel—about as thick as the length of the part you're making—for your die. Drill a hole the diameter of the body of the piece to be formed. Countersink the hole to a depth equal to about 40 percent of the hole diameter, using a standard 90-degree countersink.

Apply a drop of light oil to the hole and insert the blank part—a rod of soft steel, brass, aluminum, or other unhardened metal. It should fit snugly and project above the countersunk end of the die about  $\frac{3}{4}$  of the hole diameter. Rest the die squarely on an anvil or other suitable backing, and hammer the projecting end of the blank. Strike fairly light blows at first to avoid bending the blank. Hammer it until the top is flat and the countersunk part of the cavity is completely filled. Turn the die over and use a pin punch to drive out the formed part. If necessary, the part can be given a smooth finish by chucking it in a drill chuck and holding a file or emery cloth against it while it rotates.

You can quickly make a number of duplicate parts this way. A die of unhardened tool steel can produce several pieces before becoming too distorted, but for greater production it should be hardened and tempered.

After the parts have been formed, they should be annealed by heating (if steel)

to a cherry red and slowly cooled. Non-ferrous metals can be similarly annealed, though copper can be cooled by quenching in water. The part blank can be annealed before forming if necessary, but some extremely soft materials are difficult to drive from the cavity after shaping.

You can make many die-cavity forms with common tools—drills, rotary files, countersinks, and reamers. Heads can also be formed on rods several inches long. Insert the blank through the die block and rest the lower end on an anvil. If the rod is slender and inclined to spring, clamp two pieces of wood around it as stiffeners. Hold the die in your hand while you start to shape the head. When it is enlarged enough to be tight, rest the die on the anvil to finish shaping.

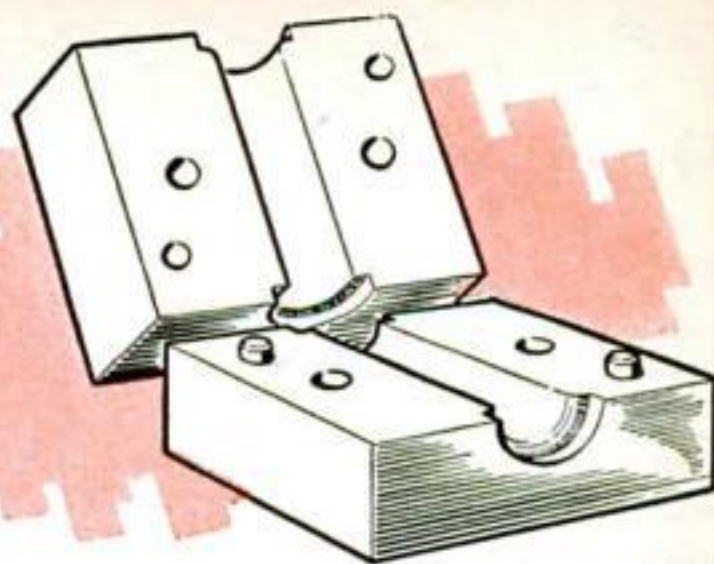
Round heads are formed using a standard rivet set with a hemispherical cavity to bring the head to final shape. You can even make a ball head using the rivet set in conjunction with a cavity in the die formed with a ball-shaped rotary file.

The possibilities of this simple method of forming small parts are almost limitless. With the solid die, you're obviously restricted to parts you can punch out when finished. But by using a split die, you can form heads on both ends of a rod. Two blocks of steel are bolted together and the cavities formed as before by drilling at the joint between the two pieces. It's a good idea to provide locating pins so the two halves will always exactly match when assembled.—*Walter E. Burton, Akron, Ohio.*

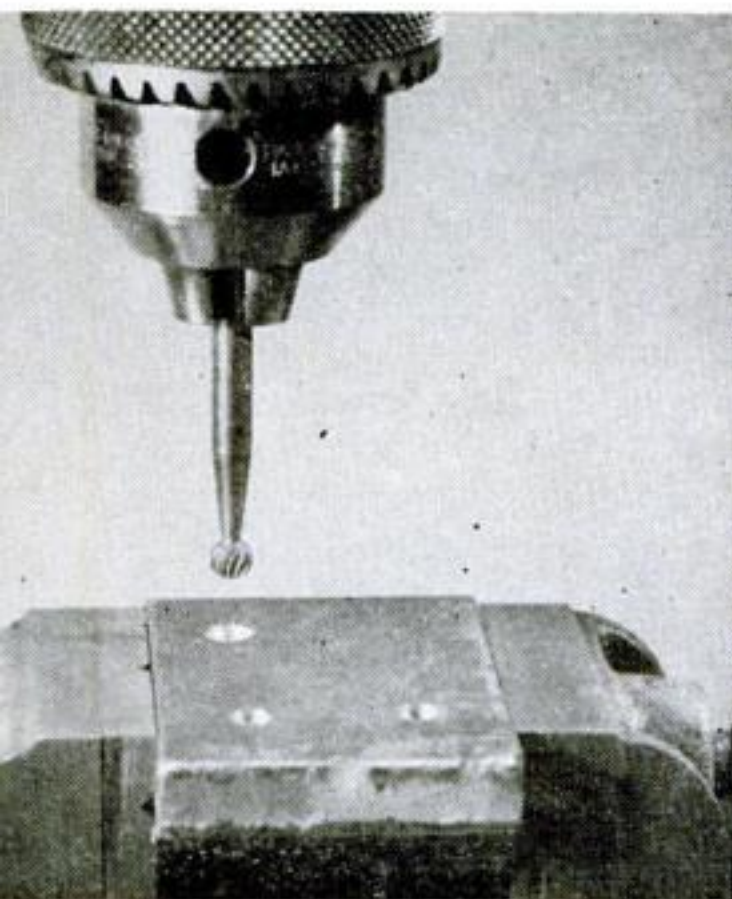




**COLD-FORMED SHAPES:** These are just a few of the possibilities. Tops of convex heads are formed with rivet set.



**SPLIT DIE** is used to make heads on both ends. Two pieces of steel are bolted together and a cavity is drilled at the joint. The die must be taken apart to remove the finished part.



**DIE BLOCK** is made by drilling scrap of tool steel, counter-boring for head shape.



**PART IS FORMED** by hammering soft blank until it expands and fills the shaped cavity.



**AFTER PART IS FORMED,** die is turned over and part is driven out with pin punch.

## The Incredible Thing Worked

"Screwball" Williams, a mechanical genius in rural Indiana, did some wild things but this topped 'em all. He bet the blacksmith he could make a new metal gear in 20 minutes. The old shop lathe needed a back gear.

Working fast, Screwball grabbed up a 9"-square piece of lumber, drilled a center hole, and nailed the wood to the bench. Taking a piece of sheet metal about 1" wide, he ran to the lathe and fed the end of the strip into the moving teeth of two meshed gears.

He scribed an 8" circle on the wood,

fastened the crinkled metal ribbon on it so that it stood on the circle held down with roofing nails. A short iron shaft was pushed into the center hole.

"How much time left?" he called, dashing toward the forge to pick up a ladle of molten Babbitt metal. He poured this into his sheet-iron mold.

"Time's up," shouted the crowd.

"Pay me," exulted Screwball. "A brand-new metal gear in 20 minutes!"

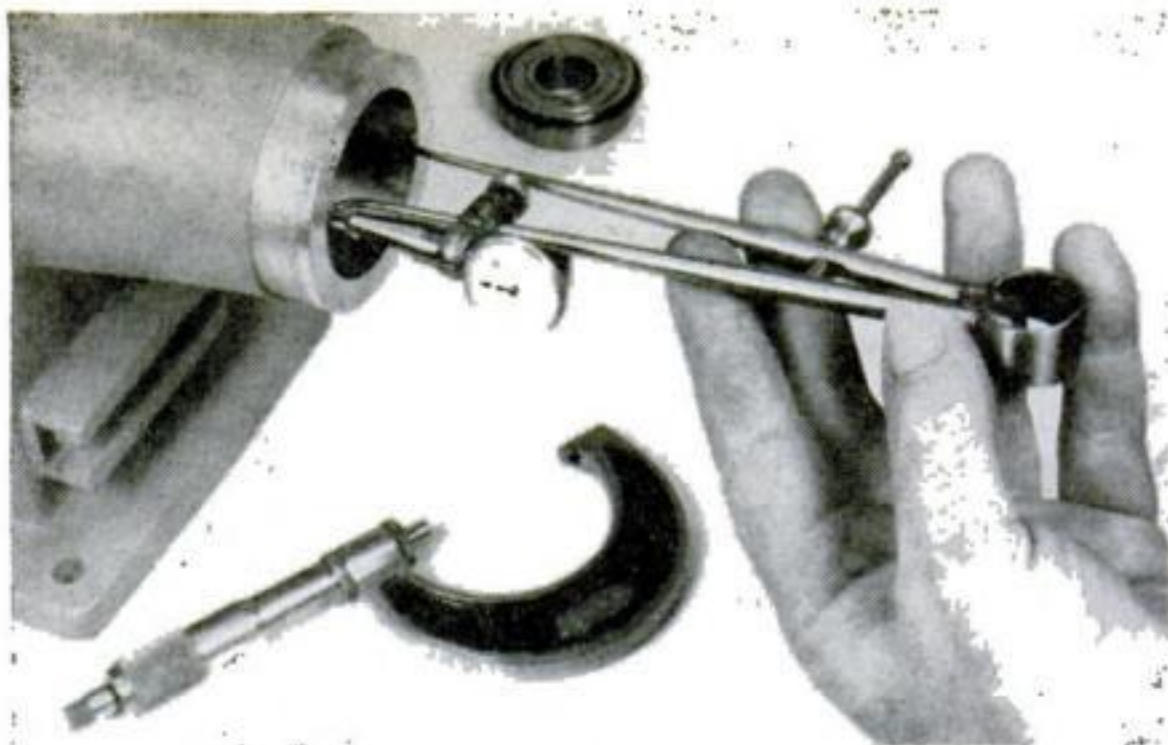
And the incredible thing worked—until the new steel gear was delivered.—*Hy Wilson, Hudson, Ind.*



## Dial Insures Delicate Touch for Greater Accuracy

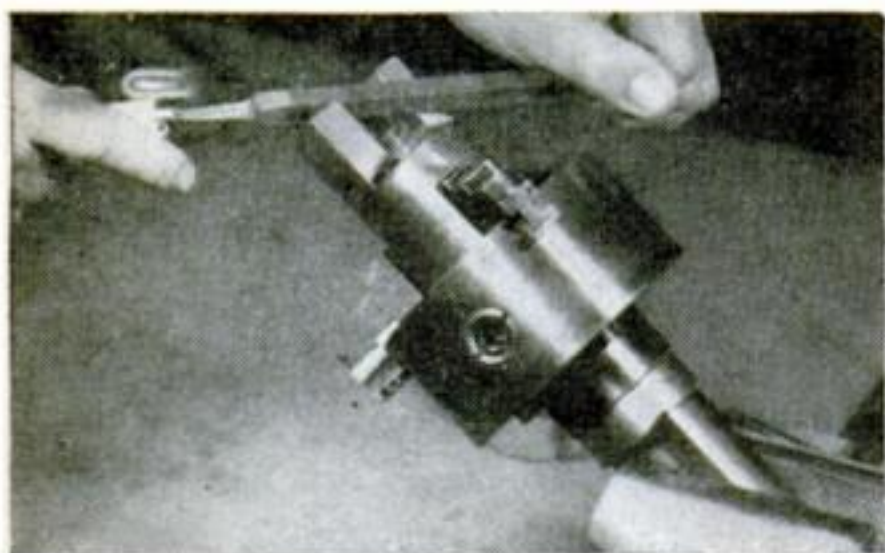
MEASURING precision bores is very difficult when tolerances are in terms of tenths of thousandths. The sense of human touch simply is not discriminating enough. An ordinary inside calipers combined with a small dial test-indicator can permit this order of accuracy. Clamped to one leg of the caliper, the indicator now acts as a pressure gauge to permit a very accurate transfer of measurement from a micrometer to the work.

The caliper-indicator is set to one of the tolerance limits of the bore size, using the outside micrometer. Now when the bore is measured, any deviation is immediately apparent if the needle varies



from the original zero setting. The dial will show directly whether size is within tolerance limits.

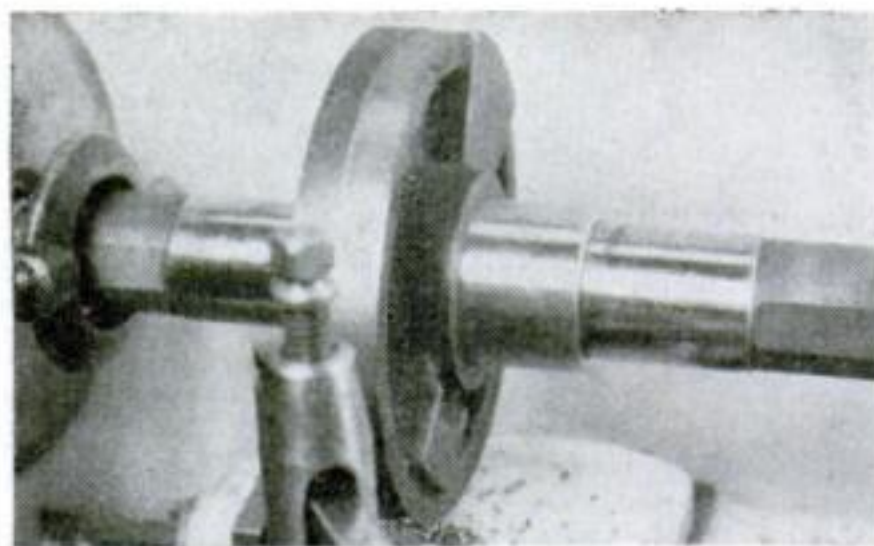
This method has proved to be very accurate as it eliminates two sources of error: one in setting the instrument initially to the mike; the other in transferring this measurement to the work.



## Lathe Chuck into Vise Tool

THIS adaptor makes it easy to use a lathe chuck in the bench vise for gripping hard-to-hold jobs requiring handwork. On one end, the turned adaptor is threaded to fit the chuck backplate. The other end is flatted on opposite sides so it can be gripped in the vise.

Not only can round work now be held securely with less chance of marring, but the job can be easily positioned at any convenient work angle.



## Bushing Adapts Lathe Mandrel

WHEN an odd-size lathe mandrel is needed, this improvisation will often prove more practical and accurate than the common practice of making a temporary soft-steel mandrel. It is much better to make use of the precision-finished, wear-resistant centers in the hardened mandrel.

An oversize soft-steel or brass bushing is press-fitted on a standard hardened and ground mandrel. The mandrel is set up between centers in the lathe and the outside of the bushing turned down to required size. Turn the o.d. of the bushing to the same slight taper that is standard on any lathe mandrel.

When the special job is finished, the bushing can be easily removed and the mandrel returned to normal use.—H. J. Gerber, Stillwater, Okla.



POPULAR SCIENCE BONUS BOOKLET NO. 17

**Home Owner's Guide to**

# Choosing Three Basic Hand Tools





**T**HREE basic hand tools are taken for granted in every home tool box: hammer, pliers, and screwdriver. You can't get along without them on run-of-the-mill jobs. Simple as they seem, they come in many varieties. (A previous booklet dealt with handsaws.)

## Choosing a hammer



**Nail hammers.** Best for everyday work around the house, nail hammers are made in two types: curved claw for general maintenance and cabinetwork, and straight claw (also called a ripping claw) designed to fit between boards for ripping and prying as in opening crates or salvaging old lumber. You can drive or pull nails with either, but the curved claw's "rocker" action offers better wood-surface protection. In nail pulling, it lessens the chance of denting the work with the other end of the hammer.

Pick a curved claw for your first hammer, a straight claw for a second one. Both types are priced about the same, around \$3.50 to \$5 for a quality hickory-handled tool, about a dollar more for one with either a solid or tubular steel handle.

**Judging quality.** A hammer works with greater power than most hand tools. A typical blow delivers a force of 45 foot-pounds, enough to throw a pound weight over a four-story house. Because hammer-nail contact may top half a ton per square inch, a hard face is a must.

A rugged handle is another essential, although its greatest strain is in pulling nails, not in driving them. A husky user may put a 100-pound load on a hammer handle to drag a nail out of a hardwood plank. Leverage boosts



the load to around 1,000 pounds near the head. So only the best handle will last.

Some quality features can be seen, some can't. A sharp V notch between claws, for instance, gives a tight jam-grip on small or headless nails. Look carefully for a two-degree toe-in that tilts the striking face of the hammer inward toward you to match the natural arc of your swing and produce square hits and fewer bent nails.

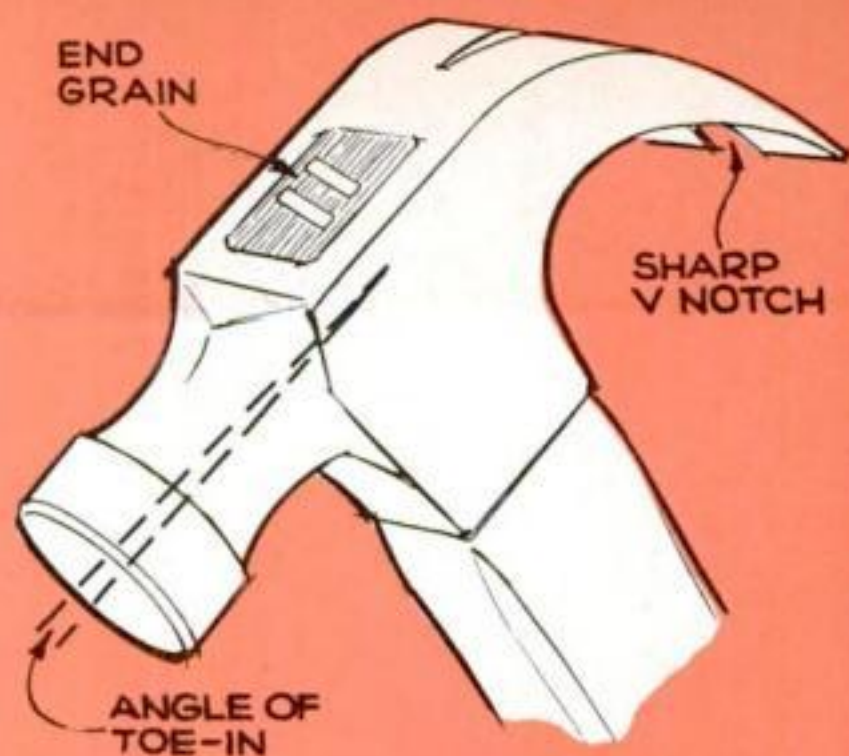
Check the end grain of any hickory handle. For peak strength the grain lines of top-quality handles run parallel to the head.

Look also for a smooth finish on striking surfaces of the hammer and on the top surfaces of the claws. Extra polished areas add only to the tool's appearance.

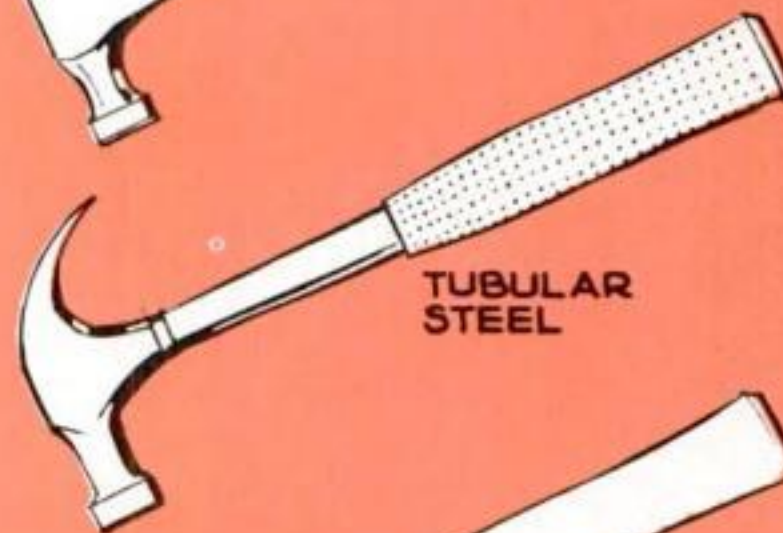
You can't identify the kind of metal in a hammer head by looking at it, so check for a label, tag, or carton legend that may state the materials used. The head should be drop-forged steel with hardened striking surfaces. It should be softer in the body portion to reduce metal fatigue. Hardness also is purposely lowered to reduce brittleness, cut the chance of breakage in certain other parts, as in slender claw tips. In some, the rim of the face may not be as hard as the inner area. This reduces edge-chipping that can result from misdirected blows.

**Handles.** Hickory, the traditional handle material, has toughness and shock-absorbing resiliency. Wedges driven into the upper end lock a hickory handle so firmly that it takes a pull of three tons to yank off the head.

To prevent loosening by dry shrinkage, don't keep a hammer near a radiator or heater. As for a tight-handled hammer, don't hang it where it's overly



HICKORY



TUBULAR STEEL



SOLID STEEL



FIBER-GLASS



damp. This swells the already tight handle in the head, crushing the wood fibers against the metal. When the handle dries, the crushed fibers make it slightly smaller. This can reduce pull-off resistance from three tons to half a ton in 24 hours, sometimes loosen the handle altogether. In a pinch you can tighten it temporarily by soaking. But it will loosen again when it dries. For protection against this trouble some brands are moisture-sealed. Many hammer handles that were properly cared for are still in use after 20 years.

Steel handles are made in two types, one tubular and mechanically locked in the head, the other solid and integral with the head in a single forging. Both are free of shrinkage problems and extremely rugged, although you may damage the tubular type by a severe blow directly against it on a miss.

It takes close to a four-ton pull to get the head off a tubular type, 10 tons to break the head from a solid one-piece forged model with an I-section handle. For shock absorption and non-slip hold both types have handgrips of plastic, rubber, or leather.

Handles made of fiber-glass, the newest type, have steel-like strength and look and feel like hickory. They are permanently factory-bonded in the head by a pour-in resin that fills the minute space between handle and head, then sets hard. Guaranteed to stay on, they have taken a million impact-machine test blows without loosening. The same pour-in bonding is also used on some hickory handles.

**Striking surfaces.** Many hammer makers offer a choice of faces. The plain face is nearly flat, likely to leave hammer marks if not carefully used. It's preferred by some for certain types

of work. For toenailing, the flat face gives good control in angling the nail at the start, lets you sink the nail by striking the final blows near the rim of the face.

The bell face is slightly more convex, can drive a nail flush or even slightly below the surface without leaving a noticeable mark. Properly used, it can also do toenailing. You'll hear strong arguments from advocates of both face types. Your best bet: Pick a bell-faced hammer if it's to be put to general use.

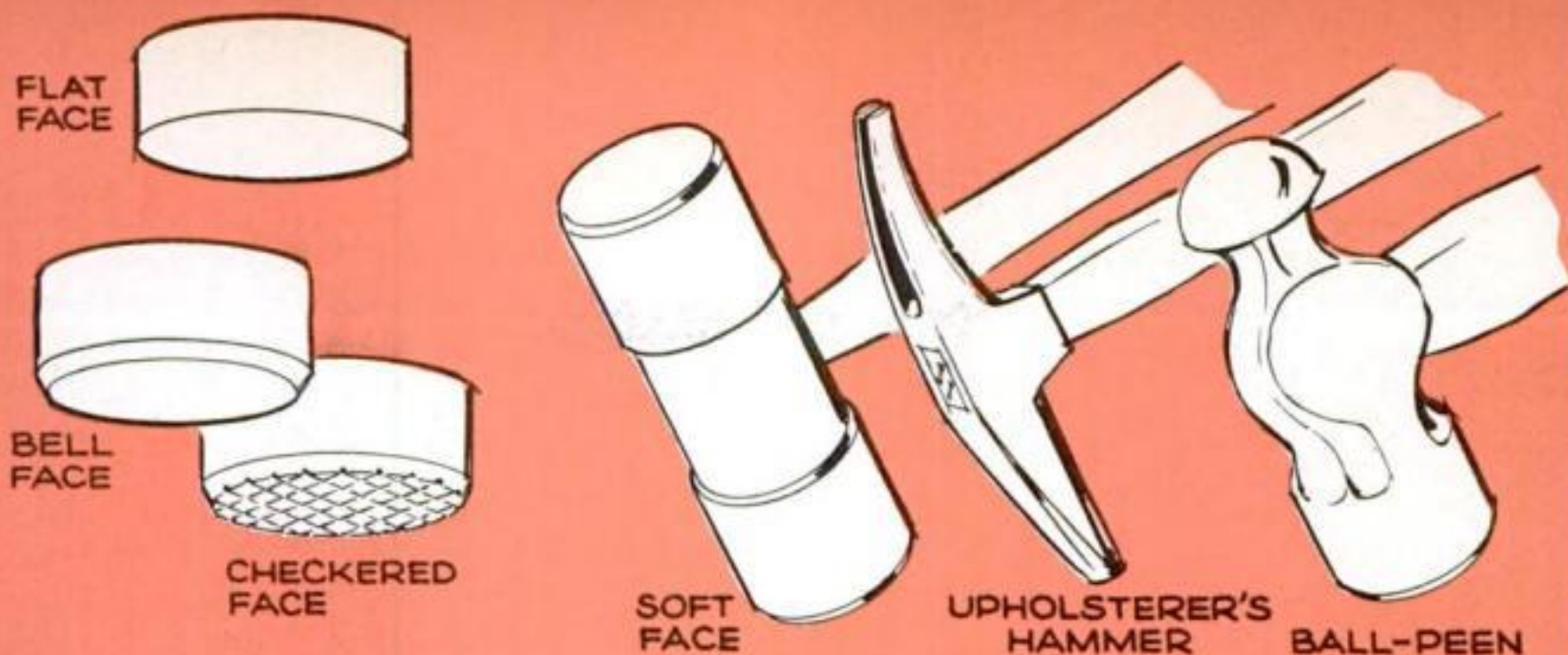
The checked face has a nonskid tread designed to minimize nail ricochet in fast work like crating and sheathing. It's not suited to general use, leaves a marring imprint, and shouldn't be used under any circumstances on finished wood or cabinetwork.

**Hammer weight.** This applies to the head only. It ranges from seven to 28 ounces in curved-claw types, is usually limited to 16 and 20 ounces in the rougher-working ripping hammers. Handle length overall runs from 12" for a seven-ouncer to 13½" in the heaviest models.

Your best weight-selecting procedure: Try several hammers of different weight in your hand, swinging each as you would in actual use. Then pick the one that feels most comfortable and balanced. The generally accepted standard is 16 ounces. For everyday household use, 10 ounces is the minimum.

**Soft-face hammers.** Important for appliance repairs, these are the only safe type where the job requires a sharp blow on a finished or threaded part, as in driving out the tapered shaft of a vacuum-cleaner rotor. The head is hard enough to separate drive-on





parts, soft enough to protect threads and bearing surfaces. It's also a good tool for roughing out dents from light metal and for driving wood-handled chisels. Select a model with screw-on plastic faces that can be replaced when damaged. Weights range from one and a half to two pounds, with a one-pounder about right for general use. You can pick up a first-rate one for about \$3.

**Magnetic hammers.** Use this type on jobs that call for holding something with one hand while tacking it with the other. Swing the hammer and you drive the tack. You can hold a no-trespassing sign over your head and tack it to a tree, or pull upholstery taut with one hand and fasten it with the other. One end of the hammer's head has a narrow longitudinal slit to form a two-pole magnet that holds the tack, with the point out, on the face of the hammer. It's the equivalent of a third hand.

With a straight head, tapered at the ends, it's a magnetic tack hammer or a bill poster's hammer. With a longer head, curved downward at both ends, it's an upholsterer's hammer. The

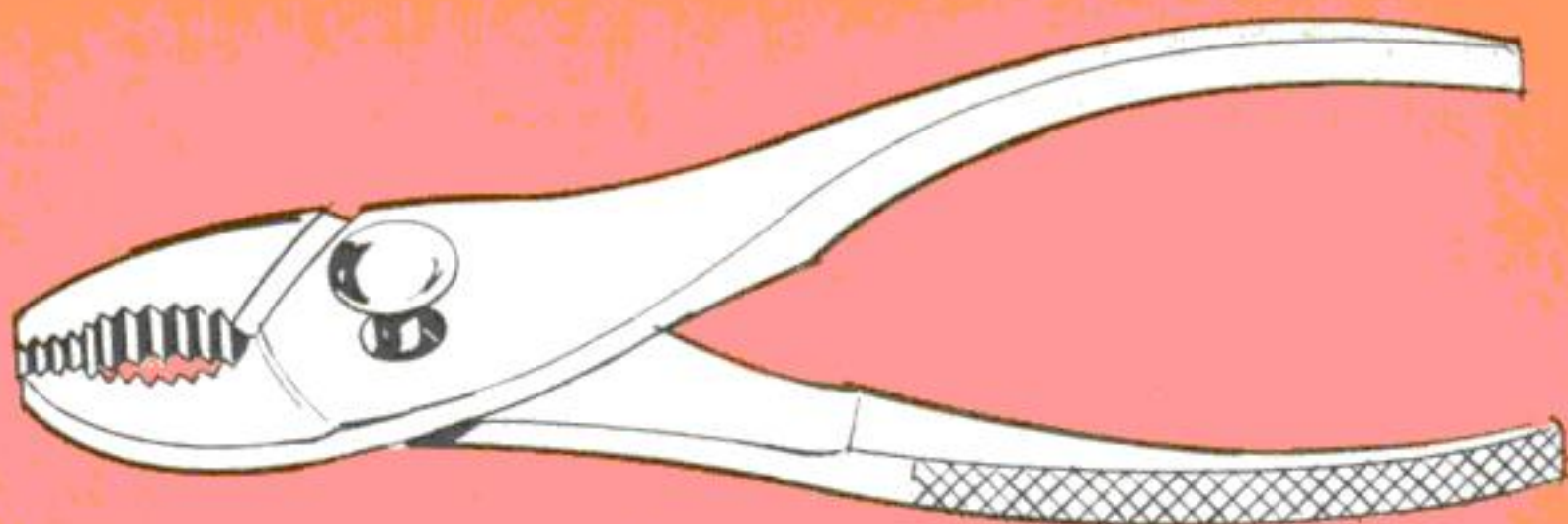
curve matches the hammer-swing arc and lets you drive tacks into a sofa seat frame close to the back without hitting it, or do other tight-quarters jobs.

For speedy work, professional upholsterers hold tacks head-out in their mouths (that's why some tack boxes are marked "sterilized") and pick the tacks out with the magnetic hammer head. Prices for good ones range from \$3 to \$4.50.

**Ball-peen hammers.** This is an all-round mechanic's type. Use it to shear off a rivet with a cold chisel or to drive a star drill into the cellar wall for an expansion bolt. Use the ball end to spread a replacement rivet, then head it over with either the ball or the face of the hammer. Weights run from four to 40 ounces. Pick a 20-ounce hammer for average work. Handle length will be around 15", price around \$3.50, materials the same as in a quality nail hammer.

If riveting is out of your line but masonry drilling isn't, you may do better with a four-pound blacksmith's hand hammer. It will set you back around \$5.





SLIP-JOINT PLIERS

## Choosing pliers

**Slip-joint pliers.** These lead the home-use field. The two-position pivot hole lets you shift gripping ranges to hold anything from hair-fine wire to pipe an inch or more in diameter.

If you have average strength you can put a squeeze of 80 to 100 pounds on the handles and produce a leverage-booster bite of around 400 pounds in the jaws. The tightest grip on the work occurs closest to the pivot in ordinary types. The smaller the surface being gripped the higher the gripping pressure, around two tons per square inch on a small lead shot—enough to flatten it.

Use slip-joint pliers to shape and splice wire, bend sheet metal, hold hot parts while soldering, and other shop jobs. Although the practice is frowned upon, you can also use them to tighten nuts when you lack the proper size wrench.

Wire cutting is done with one of three cutter types. The commonest cutter in slip-joint pliers consists of squared sections on each jaw. These cut with a shearing action as the jaws close. This requires a well-fitted plier-

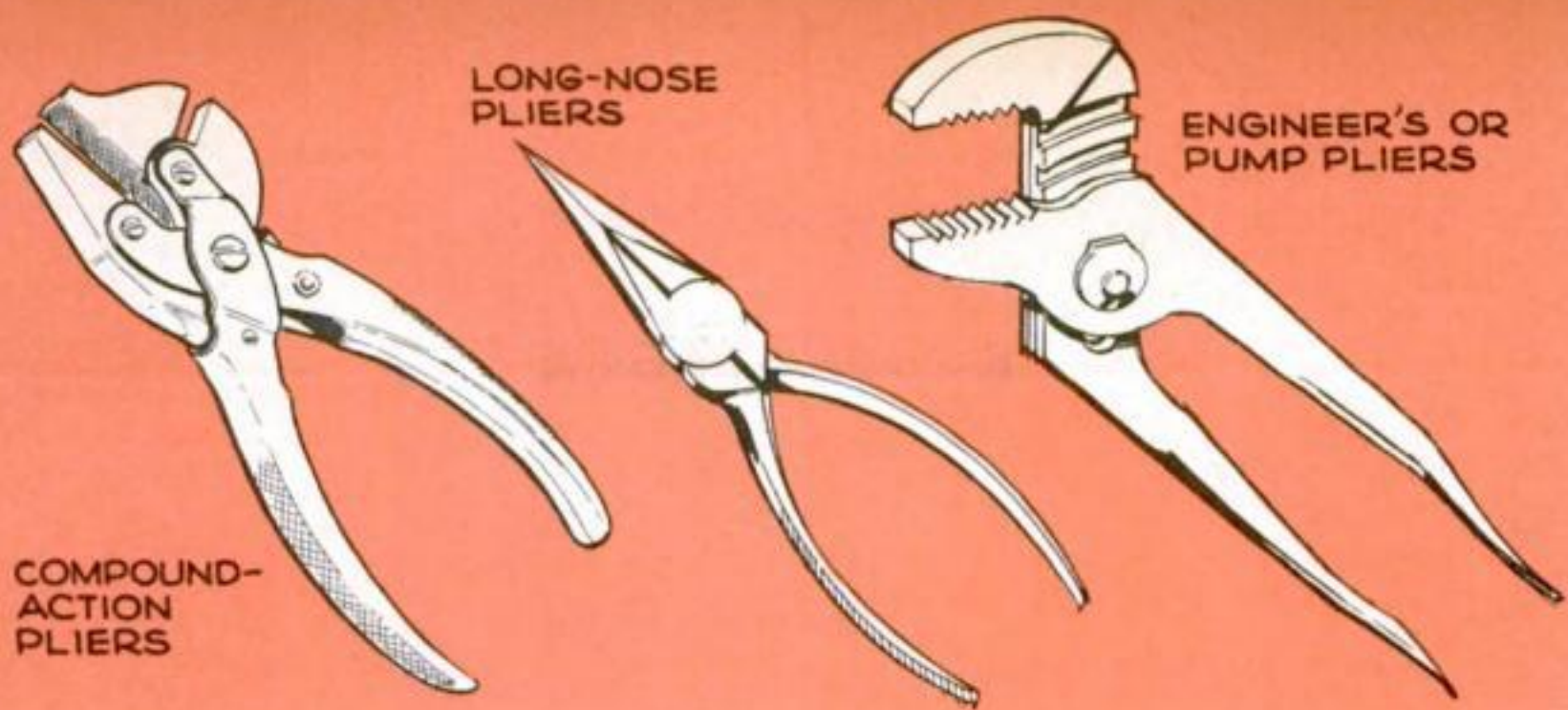
pivot stud; a loose one merely bends the wire without cutting it.

The side cutter is more positive. This consists of a short, chisel-like blade on each jaw. Blades meet edge-to-edge when the pliers close, making a clean, crushing cut. This cutter is used on most lineman's and electrician's pliers and on some of the slip-joint models.

The button's cutter is not so common although it's highly efficient. It consists of wire-size notches on each jaw, sometimes three pairs on a single tool. As the pliers open, the notches line up so a straight section of wire can be inserted. As the pliers close, the notches shift past each other and shear the wire.

Top-grade slip-joint pliers are hammer-forged, tempered steel. It should not be possible to shift them from one pivot position to another except when the jaws are wide open. Don't judge them by thickness or weight as quality models are often made light and slender for aircraft use or cramped work. Popular lengths are 6" to 7", prices around \$3.50 or less.





**Compound-action pliers** are designed to maintain parallel-jaw position at all openings for a firm grip on flat-sided objects. Because of their operating principle, gripping pressure doesn't diminish from the pivot outward as in simple lever pliers. Use them for a wrench-like grip on nuts, even on some types of woodwork, as in gripping and removing stop strips to replace sash cords in windows. A 6½" length sells for about \$3.25. In smooth-jawed form they're used by glass workers to get a solid hold and click off narrow glass edges after cutter-scoring, and for handling chromed fittings.

**Long-nose pliers** are made in many forms, and sell for \$2.50 to \$3.00. The handiest, for general use, is the chain-nosed type. These have tapered half-round-sectioned jaws with flat, serrated gripping surfaces. For work on radios, clocks, jewelry, or models, select a pair with about 3" jaws tapering to ⅛" or 1/16" at the tips. They'll reach deep into small mechanisms to adjust, replace, or retrieve parts. They'll also form tiny parts in wire or strip metal. For tight-spot use, some are automatically opened by a spring placed be-

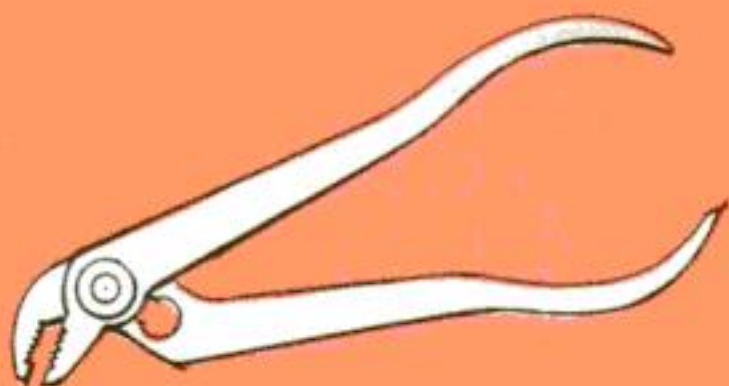
tween the handles, a feature worth having.

Check for a precision fit in the pivot stud and perfectly aligned jaw tips (a good bet on any pliers). If pliers have a side cutter, it seats first and may result in a slight gap between the jaws. If you want to grip fine wire or shim stock, you can buy a model without the cutter.

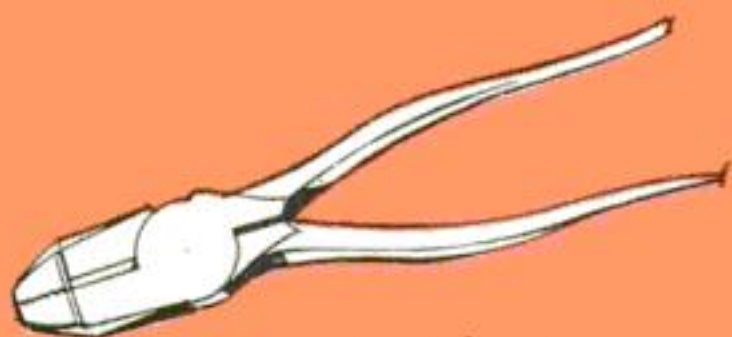
**Engineer's or pump pliers** are also called plier wrenches (price around \$2). These have pivot-shifting systems ranging from simple slip joints to positive ridged channels that provide from four to eight settings for an approximate parallel-jawed grip at openings from 0 to more than 2".

You'll find that these pliers are a lot quicker than a wrench on many minor plumbing jobs, tightening pump-packing nuts (hence the name) and for any plier work where the extra gripping leverage of their usual 10" length is needed. At least one make has smooth jaws for plumbing-fixture work. More specialized than the slip-joint pliers, they're an ideal second tool for hold-and-turn jobs not possible with a single pair.





BATTERY PLIERS



ELECTRICIAN'S PLIERS



NIPPERS

**Battery pliers.** While these are strictly a special-purpose design, their low cost and high gripping power make them a very useful tool in the shop and car. Their usual 8" length and short, angled jaws, designed to get a nonslip bite on badly corroded battery nuts, can do the same job on any other nut too badly rounded or damaged to turn with a wrench. Because of their special purpose, jaws don't close all the way. So don't buy them for general use. The price for good battery pliers runs from \$1 up.

### Lineman's and electrician's pliers.

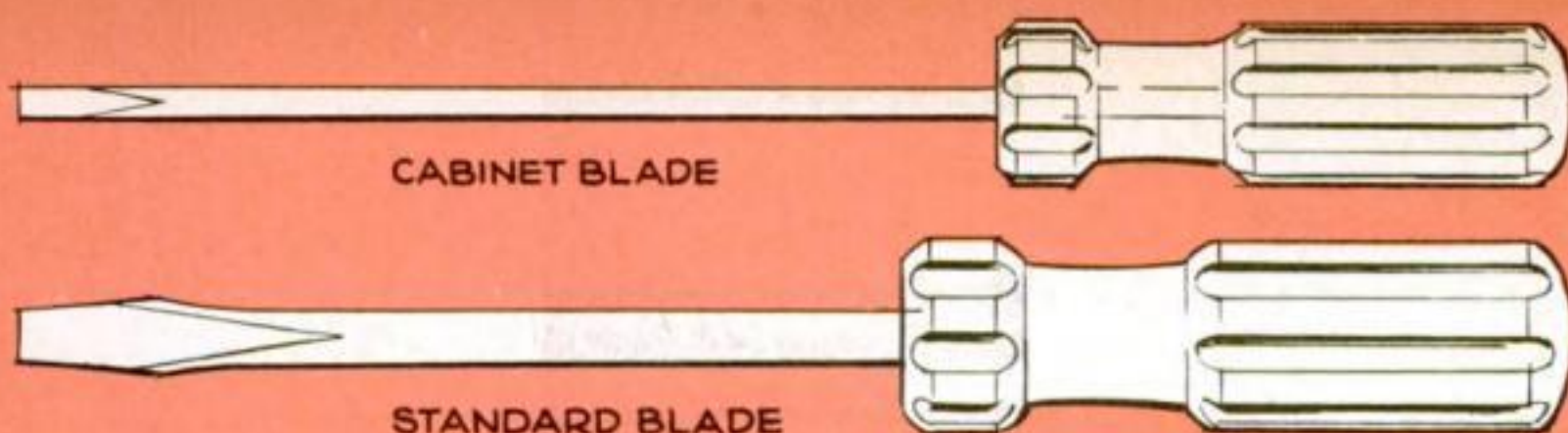
These are a side-cutting type with broad jaws designed for splicing and general wiring work. They have a precision-fitted pivot stud, no slip joint, no deep-toothed section for large objects. Some models incorporate a wire stripper. Lengths range from 4" on a short electrician's plier to 8½" for typical lineman's models. These are heavily made special-purpose tools, and are priced in the neighborhood of \$3.50.

**Nippers.** Although these are not pliers in the strict sense, they are a generally similar tool, useful around the house in many ways. The handiest, from the home owner's point of view, is the end nipper. In place of plier jaws it has a pair of cutting blades at right angles to the handles. It can snip off almost flush a nail end protruding through a board. By applying less pressure on the handles you can grip the nail and pull it by rocking the nipper like a nail hammer, and you can do it in tight spots where a hammer couldn't possibly be used.

You can easily grip the protruding point end of a finishing nail with enough power to pull the head through the wood—often the best way to remove it without surface damage. It's also a handy tool for cutting fencing and wire mesh. Sizes range from 6" to 8". For easy cutting of heavy wire, you'll find the long model the better bet. Prices of nippers are usually from \$2.50 to \$3.

Insulated handles are available on pliers and some nippers used in electrical work, factory installed at slight extra charge, or as a slip-on accessory at around 50 cents a pair. An extra advantage: They help to cushion your hands.





## Choosing screwdrivers

**Standard screwdrivers.** Three are enough to cover the range of screw sizes used on most hardware around the house. One should have a cabinet-type blade with a tip  $\frac{3}{16}$ " or  $\frac{7}{32}$ " wide. This is a parallel-edged tip equal in width to the diameter of the round shank. It's especially suited to turning screws in deep holes and recesses.

Your other two screwdrivers should have  $\frac{1}{4}$ " and  $\frac{5}{16}$ " blades of standard angular form, slightly wider above the tip. This is a traditional high-strength form with an added advantage: The wider upper area of the blade tip allows room for gripping with an adjustable wrench if necessary on an occasional tough-turning job.

**Match driver and screw sizes** like this for maximum efficiency:

Blade-Tip Width	Blade Thickness	Screw Size
$\frac{1}{4}$ "	.037	6 to 8
$\frac{5}{16}$ "	.037-.039	8 to 12
$\frac{3}{8}$ "	.040-.050	12 to 16
$\frac{7}{16}$ "	.050-.064	16 to 20
$\frac{1}{2}$ "- $\frac{5}{8}$ "	.060-.070	20 to 24

Smaller sizes are often of a special type. Your best bet then is on-the-spot matching of screwdriver and screw. Wood-handled types are priced from 35 cents up, a king-sized two-

footer with  $\frac{1}{2}$ " blade tip, about \$3.50.


**Look for a cross-ground blade** on a standard screwdriver. You can see the grinder marks across the blade in larger sizes, feel it with your fingernail in small ones. This grind assures accuracy of the eight-degree angle between faces (sometimes 10 degrees on heavy-duty drivers) and reduces the chance of the blade slipping out of the screw slot. Tests show that cross-grinding serrations bite into screw-slot edges to give 300-percent better holding power than other blades, producing a 20-pound grip on a typical screw under torque.

If a cross-ground blade wears smooth at the tip from long use, manufacturers advise dressing the blade crosswise with a bastard-cut file instead of a grinder. The file is harder than the screwdriver, even though the latter is hardened.

The blade should not be sharp. Instead, the end should be blunt and squared off so that it will fit in the bottom of the screw slot. To make a transition from angled to straight, the blade sides of many screwdrivers are ground slightly concave.

**Phillips screws.** Four Phillips screwdrivers will cover the complete range






PHILLIPS  
BLADE



SIMPLE  
RATCHET



SPIRAL  
RATCHET



STUBBY  
DRIVER

of Phillips-screw sizes, though you will probably have little use for the smallest one. They match up this way:

Screwdriver-Tip Size	Phillips-Screw Size
1	0 to 4
2	5 to 9
3	10 to 16
4	18 to 24

On cars and appliances you may sometimes encounter screws that look like the Phillips type yet won't fit the Phillips screwdriver. These are Reed & Prince screws that require their own form of driver. Spot them by slightly narrower slots.

Another form you may find in mechanical work is the clutch-type screw, often called a figure-eight or butterfly screw because of the shape of the recess in the head. Unless you have a large number of those to handle you can get along with a standard screwdriver of a size that fits into the recess. Don't use a Phillips screwdriver on them.

**Simple ratchet.** Turn the handle of this type of screwdriver back and forth; the blade turns in one direction only. Set it to turn either way or lock it rigid. Use it in tight spaces for ratchet speed and convenience when a spiral ratchet type won't fit. Judge it by the number of stops, or clicks. The

more the better, as you can reverse it at more points and get turning movement with less swing.

**Spiral ratchet.** This type turns the screw when you push down on the handle. Set it for either direction with a simple adjustment to drive or remove screws, or lock it rigid for use as an ordinary screwdriver. A typical model makes three complete turns with a single push, returns to extended position by spring action. The mechanism of a spiral ratchet driver should produce easy turning, without any sign of wobble between handle and blade tip.

Use it on extensive jobs like boat-building or major cabinetwork. With quick-shift interchangeable bits you can use the same tool to drill and countersink the holes in which the screws will be driven. The push-in action calls for about a foot of space above the screw for small models, around two feet for large ones. Prices start around \$3.50 to \$4.

**Stubby screwdrivers.** This is the manufacturers' term for types with an overall length of about 3½". Use them where space above the screw is very limited. Cost: less than \$1.

**Offset screwdrivers.** These have a lever-type handle, usually about 6"





long, with a short blade at right angles to it at each end. Use them where you need high turning power in close quarters. An offset is small enough to carry in your vest pocket, works in tight spots, but can equal the torque of a standard 8" model. Solid bar type, about 50 cents; ratchet type, about \$1.

**Screw-holding screwdrivers.** These are made for standard and Phillips-type screws. Commonest form has spring-closing jaws that hook under the screw head to hold it on the blade tip. Use it to insert and start screws in hard-to-reach spots. After the screw

is started, pull back on the screwdriver and the jaws will release the screw automatically. Prices: from 50 cents.

#### **Screwdriver bits for the bit brace.**

These are generally available in sizes from  $\frac{1}{4}$ " to  $\frac{1}{2}$ ". You'll probably have most use for the  $\frac{3}{8}$ " tip width as it covers the commonest screw sizes likely to call for bit-brace turning power. You can use this type for everyday screwdriving and for the tough, hard-turning jobs. But remember, your bit brace gives you enough leverage to break the screw, even the screwdriver bit. Prices: from 75 cents.

## **General tool pointers**

**Hammers.** Don't hammer anything harder than the hammer itself. Use hammers for their intended purpose—don't rivet or drive a cold chisel with a nail hammer. Use a pry bar—not hammer claws—for heavy prying.

**Pliers.** Lubricate the pivot stud occasionally with light oil. Don't use a pipe or tube to extend handle leverage. Keep serrations and jaw teeth clean with a wire brush. If you hold hot objects in pliers protect them from excess heat.

**Screwdrivers.** Use the right size for the screw. Don't use a screwdriver as a pry bar or chisel, and don't hammer on the head. Never use pliers or a wrench on the handle for added torque. Where you need high torque, use a square-blade shank designed for wrench-turning. Use an insulated handle in any electrical work where live-wire contact is possible. To avoid shorts, buy a type with an insulating sleeve over the blade shank, or slip rubber tubing over your regular screwdriver for the same protection.



**P.S. EXTRA:  
YOUR TEAR-OUT  
BOOKLET NO. 17**



**T**o remove this booklet, place your left hand on the facing magazine page, grasp the booklet with your right, and pull it gently away.

After reading, file for future reference. You'll find it valuable on many home jobs.

*June 1960*

**POPULAR SCIENCE**





# Vacation Driving Tips



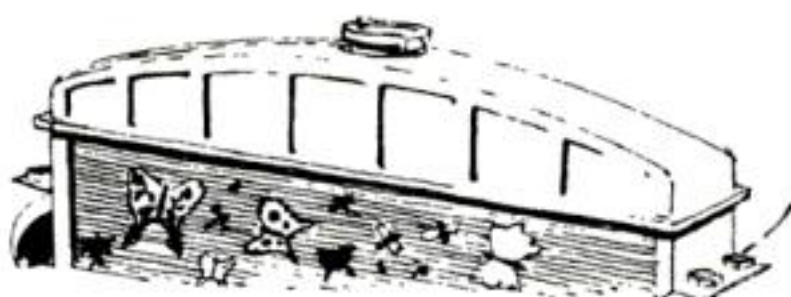
**IN HILLY COUNTRY:** Use the low range of an automatic transmission instead of brakes on downgrades. Lock out overdrive if you have it, shift to second.



**IF YOU HAUL A TRAILER,** check the automatic-transmission fluid more frequently than usual. A low fluid level plus the extra load tends to cause foaming and overheating.



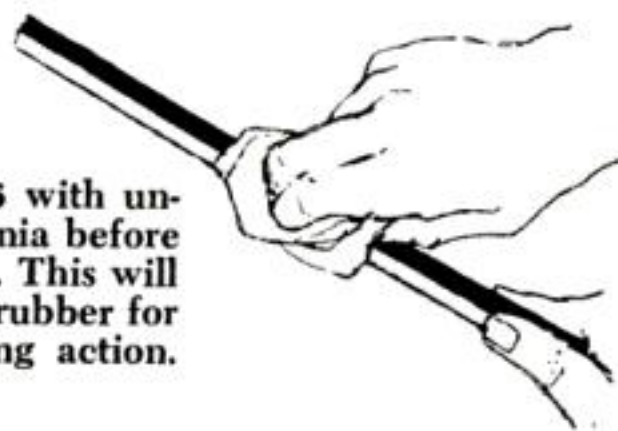
**HUBCAPS,** plastic bags, even a bathing cap can be used to carry water from a stream to an overheated radiator. Pour it in slowly.



**CHECK THE RADIATOR FRONT** occasionally when you make a service stop. Bugs quickly cover it in summer, restricting normal air flow.



**RAISE THE HOOD**—it'll hold on the safety latch—when car is overheating in traffic. The extra opening helps vent off engine heat.



**CLEAN WIPERS** with undiluted ammonia before starting a trip. This will condition the rubber for a better wiping action.



**DAMP CLOTH ON THE FUEL PUMP,** fuel line, or carburetor bowl is a good prescription if you suspect that vapor lock has caused the engine to stall. Evaporation cools the fuel.



**VACATIONING IN THE MOUNTAINS?** Have the radiator pressure cap checked. Water boils easier at high altitudes, and a properly pressurized cooling system raises the boiling point.



# Lawn-Keeping: the lazy man's version

**By Dr. Robert W. Schery**

*Director, The Lawn Institute*

**Y**OU can be the world's laziest lawn-keeper. You can hate the work. You can find every excuse for not tending your grass. Yet you can have a pretty good lawn. In fact, it can be first-rate.

Now, this requires a mite of qualification. Naturally, you can't *completely* neglect your lawn except at the expense of a poor cover and a running argument with your wife. But you certainly can save yourself a lot of work this summer.

Grass is hardy and cooperative. Properly seeded and given ordinary attention, grass will flourish. Considerately handled, it holds off crabgrass and chickweed. It tends to enrich its own soil. It resents such overattentions as hard rolling and excessive watering or feeding.

Much needless work is done on lawns because of popular delusions. Here are some widely held—and largely erroneous—beliefs about lawns:

- Grass requires a lot of close cutting.
- Lawns require a vast preparation of the soil before seeding.
- Lawns invariably require rolling.
- Most lawns require topsoil.
- Lawns benefit from and need manure.
- Weed sprays are the only recourse for crabgrass.
- Lawn clippings must be swept up.
- Lawn feeding is as helpful one season as another.
- Lawns need a lot of water.
- Lawns are prima donnas, need attention ranging from spiking to bug tonics.

Well, let's see. Let's consider the lazy man's lawn. Let's see what grass will do for you when you don't try to do too much for it. Let's see how you can keep from killing your lawn with kindness.

## **Grass clippings are gold**

Take mowing. Most home owners clip the grass much too close. Their lawns

look like a high-school boy with a brush cut. Actually they are only making work for themselves—weeds thrive among short grasses.

A good stand of grass will do most of its own "weeding." It crowds out most weeds if long enough. Mower blades should be no lower than three inches off the ground in the summer in the southern portion of the Kentucky bluegrass belt (or, roughly, the northern two-thirds of the nation).

Do you collect all your grass clippings meticulously and dump them? Stop it! Clippings are full of nutrients. Short clippings settle down near damp soil, decompose, and release their fertility. You will have a little brownness as the clippings wither, but it will last only a few hours.

There is one exception to remember. The trailing grasses do build up a mat when clippings are allowed to settle. This creates a thinning problem. But Kentucky bluegrasses and red fescues don't. Let your investment in them grow. It's money in the bank and fewer backaches at day's end.

## **Watch that water!**

You can become a respected member of the League of Lazy Lawn-Keepers by resisting the temptation to water too much. Just because some water is good doesn't mean that a lot of it is better. Waterlogged soil lacks air in the root zone. Roots are forced to the surface. Wet soils compact when equipment is run over them.

Frequent watering encourages grass species that only make additional work. Bentgrass, *Poa annua*, and *Poa trivialis* thrive on water. But they are prone to ailments. They need fungicide, thinning—and continued watering and feeding to hold up.

During dry periods a lawn will go off-color if unwatered. But well-established bluegrasses and fescues don't die. They only fade. Drought hurts weeds more than it does these grasses.



## Be lazy about feeding

If you're in a hot climate, take the lazy man's way out with fertilizing this summer. It will pay off. Fertilizing at the appropriate season is imperative. But "appropriate season" depends on climate and kinds of grass. Bluegrass-fescue lawns enjoy feeding most in the autumn, for they build reserves in cooler weather. Where summers are cool, and lawns watered, fertilizing may continue the year 'round.

But where summers are hot—and that's most everywhere—cut down on feeding bluegrass, or stop it altogether. Hot weather and fertilizer nitrogen don't mix on a lawn. The grass turns soft, can't stand the heat, and succumbs to disease. The nitrogen often is wasted because it volatilizes, and because grass can't use it when heat slows growth.

You can also "burn" good grass in hot weather with exuberant feeding. Even the new slow-release fertilizers may yield too much nitrogen in summer heat for the northern grasses.

Be careful with weed killers when using them. Overdosing is murder to grass. Moreover, if applied carelessly it can drift to, and kill, shrubbery.

The lazy lawn man's dream in weed killers is 2,4-D. One quick treatment with

[Continued on page 198]



**TAKING IT EASY** is a fine rule for maintaining a good lawn, says this expert. And what better advice could you ask during the sunny summer days? A hammock will ornament any lawn.



# New Ideas in Photography

**Dramatic advance in flash photography!**

## Compact flash camera takes bright, full-size pictures

**—uses bulbs as small as jelly beans**

Meet the smallest camera with built-in flash in Kodak history!

The new Brownie Starmite Camera fits in your palm or pocket—yet uses regular 127 film for big prints or super-slides. It's always ready—indoors or out, day or night.

The built-in reflector is only two inches across. With tiny low-cost, zirconium-filled AG-1 flashbulbs, it can flood a room with light. Flash exposure data is printed right on the camera itself.



New Brownie Starmite Camera—so small it fits *inside* an old-type 5-inch reflector.

No focusing. Just aim through the big viewfinder and press a button. Results? Beautiful color or black-and-white snapshots, or color slides—12 pictures to a roll. And it costs only \$10.50.

For the same efficient flash system, but even larger pictures on 620 film, see the Brownie Flashmite 20 Camera, \$14.95. Or ask about equipping your present camera with the \$3.95 Kodak Supermite Flashholder that uses the same new AG-1 bulbs.

*"Picture it now—See it again and again."*



New Kodak projector adds sound to 8mm movies.

## New Alloy Brings Quality Sound To 8mm Home Movie Projection

A new metal alloy developed by the Navy—called Alfenol—has led to a major breakthrough in magnetic sound reproduction.

Used in the magnetic recording head of the Kodak Sound 8 Projector, it lets you add sound to 8mm movies with exceptional realism.

Alfenol is "soft" magnetically, so it assures high-quality sound reproduction. And it is physically very hard, making it virtually impossible to wear out. Kodak Sound 8 Projector costs \$345.



# from Kodak

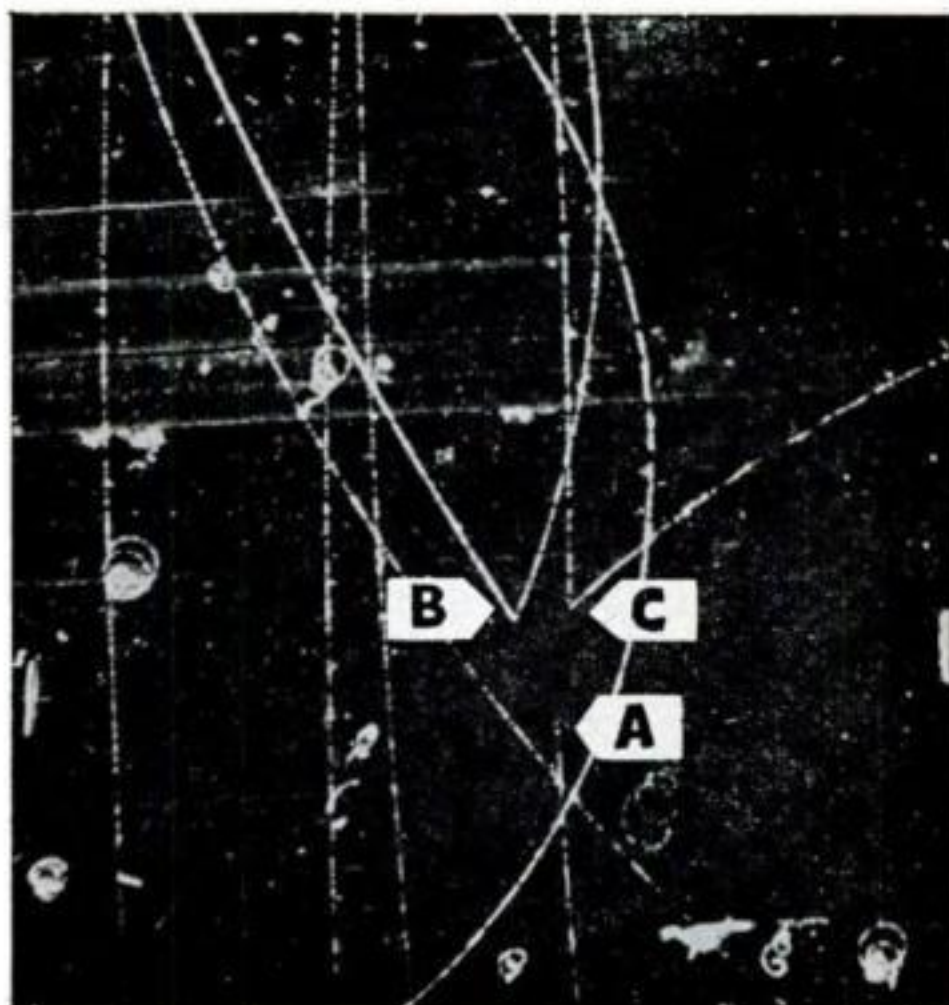
## Atomic "Missing Links" Are Found Through Bubble-Chamber Photographs

The birth and death of an invisible atomic particle called the "anti-lambda" was recorded recently on Kodak film. ▶

The particle was released by the action of a giant 6-billion-electron-volt accelerator discharged in a bubble chamber of liquid hydrogen. The particle left a trail which could be captured and studied only through photography.

To get the pictures, physicists chose Kodak Linagraph Shellburst Film, originally created to analyze anti-aircraft explosions. Its fast speed, high contrast, and moderate grain helped lead to this atomic discovery.

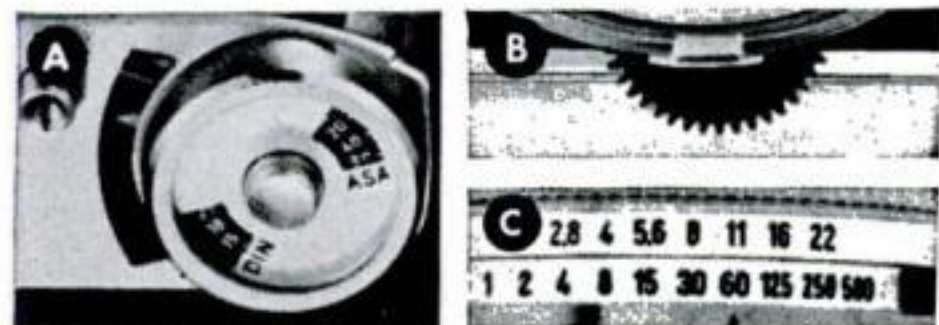
Knowledge gained by Kodak in developing such specialized products for science and industry assures ever-finer films for amateur use.



**Bubble-chamber picture** shows point (A) where lambda and anti-lambda particles were produced. Since both are neutral electrically, they left no tracks until decaying into particles leaving tracks (B) and (C)



New Kodak Retina Reflex S with built-in meter.



**For exposure control**, aim the camera at your subject. You will see the meter needle move in the window (A). By turning a finger-tip wheel (B), you cover the meter needle with a pointer. This automatically gives you the right lens opening. If you change shutter speeds (C) the lens opening readjusts automatically.

## Change Camera's Shutter Speed—Lens Opening Adjusts Automatically

Why is one of the world's most advanced and versatile cameras so remarkably easy to use?

Partly because the new Kodak Retina Reflex S Camera has *photoelectric* exposure control with all lenses, all shutter speeds, all films.

Partly because you aim directly through the lens, see your subject natural size. And your view is clear even in dim light. The automatic diaphragm keeps the lens *wide open* until you snap the picture.

You focus either on ground glass, or with a critical split-image rangefinder. Automatic indicators show near and far limits of sharpness.

Speed settings go from one second to 1/500, and a scale shows exposure needs up to 250 seconds for dim-light or small-aperture shooting. Interchangeable lenses from 28mm to 135mm are available as well as specialized aids.

See the great Kodak Retina Reflex S. With 50mm *f*/1.9 lens, \$235. With 50mm *f*/2.8 lens, \$199.50, or as little as \$20 down.

Prices are list, include Federal Tax where applicable and are subject to change without notice.

**EASTMAN KODAK COMPANY, Rochester 4, N.Y.**

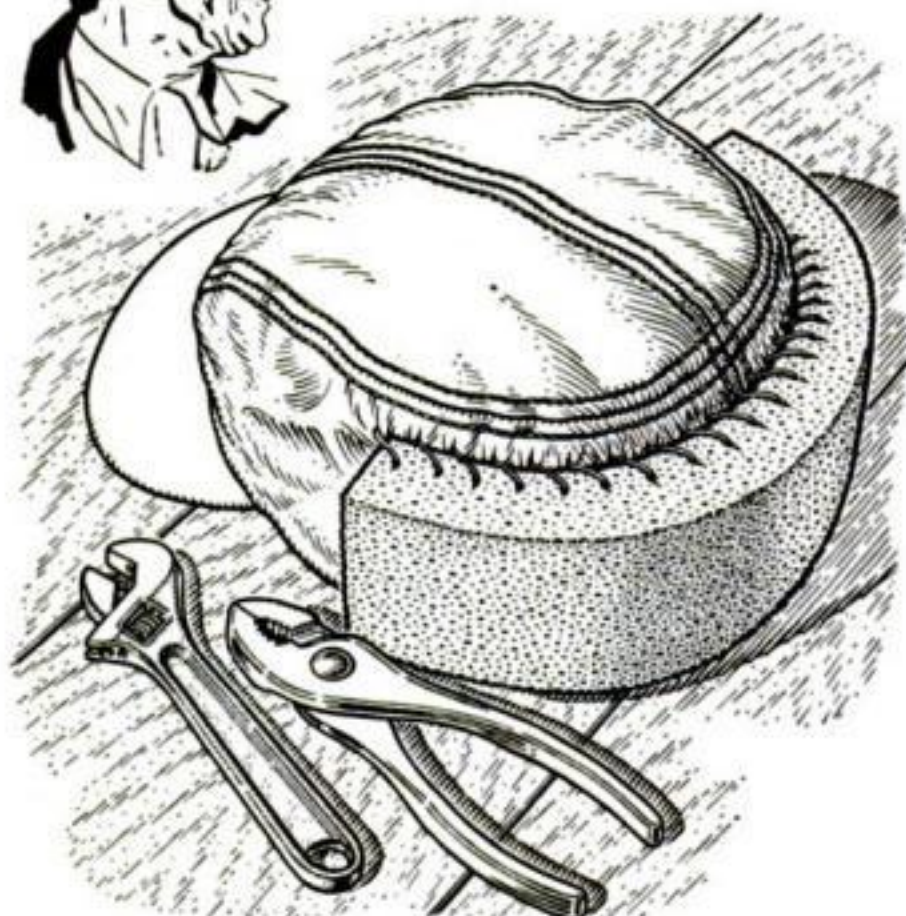
See Kodak's "Adventures of the Nelson Family" and "Ed Sullivan Show"

**Kodak**  
TRADEMARK

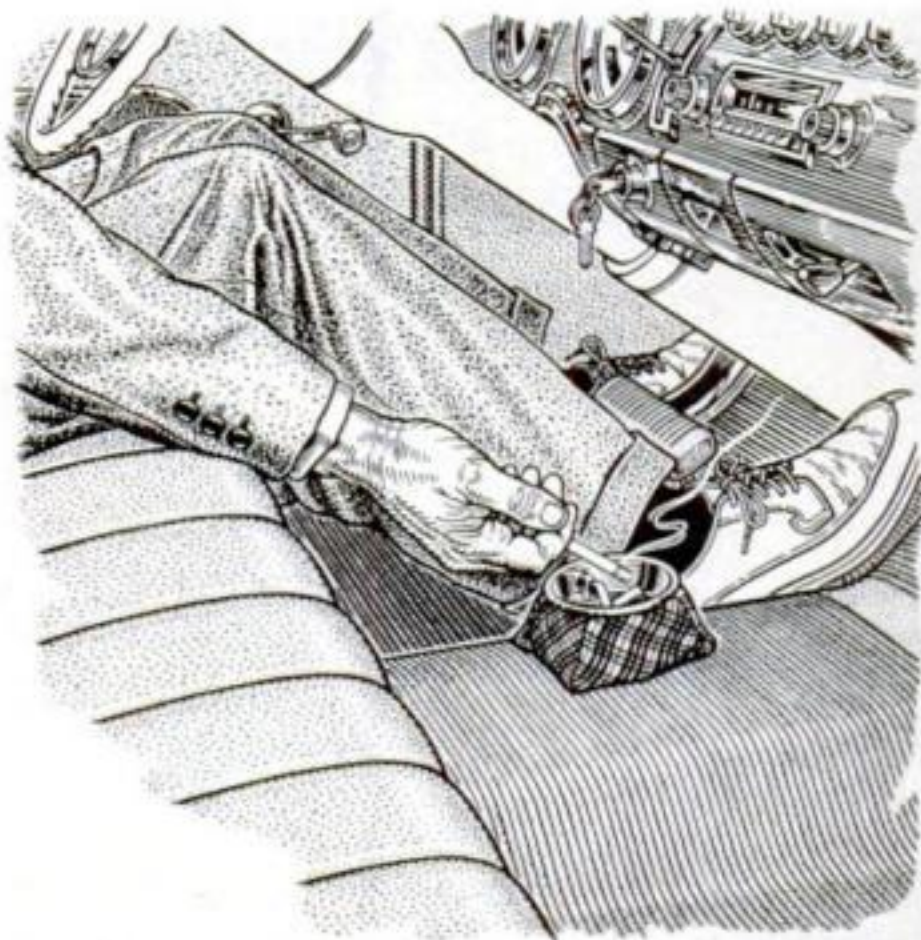




## Hints from the Model Garage



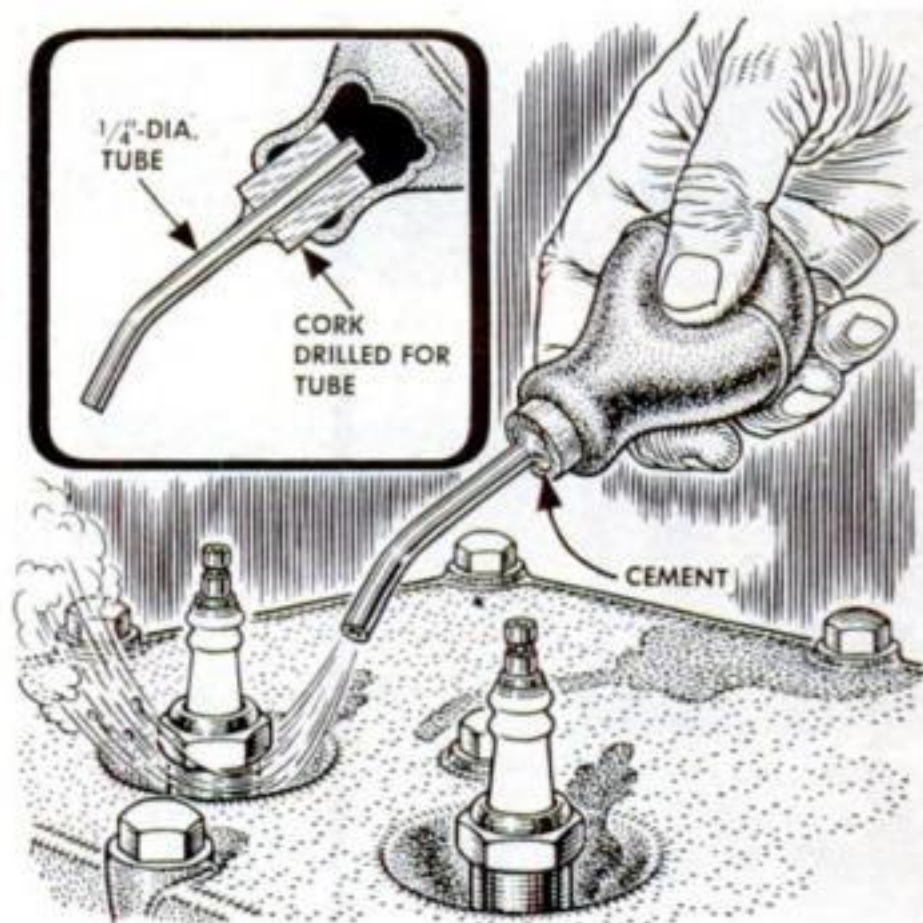
**For a comfortable head rest** when you're lying on your back beneath a car, sew a strip of foam rubber around the back of a work cap. Cut a piece about 1½" thick by 3" wide and 10" long, and stitch it in place with heavy thread.



**Need a convenient ash tray** that will stay put in a moving car? The bean-bag type that's sold in novelty shops and dime stores is ideal. The shot-weighted pouch absorbs road bumps and won't bounce around when kept on a flat surface.

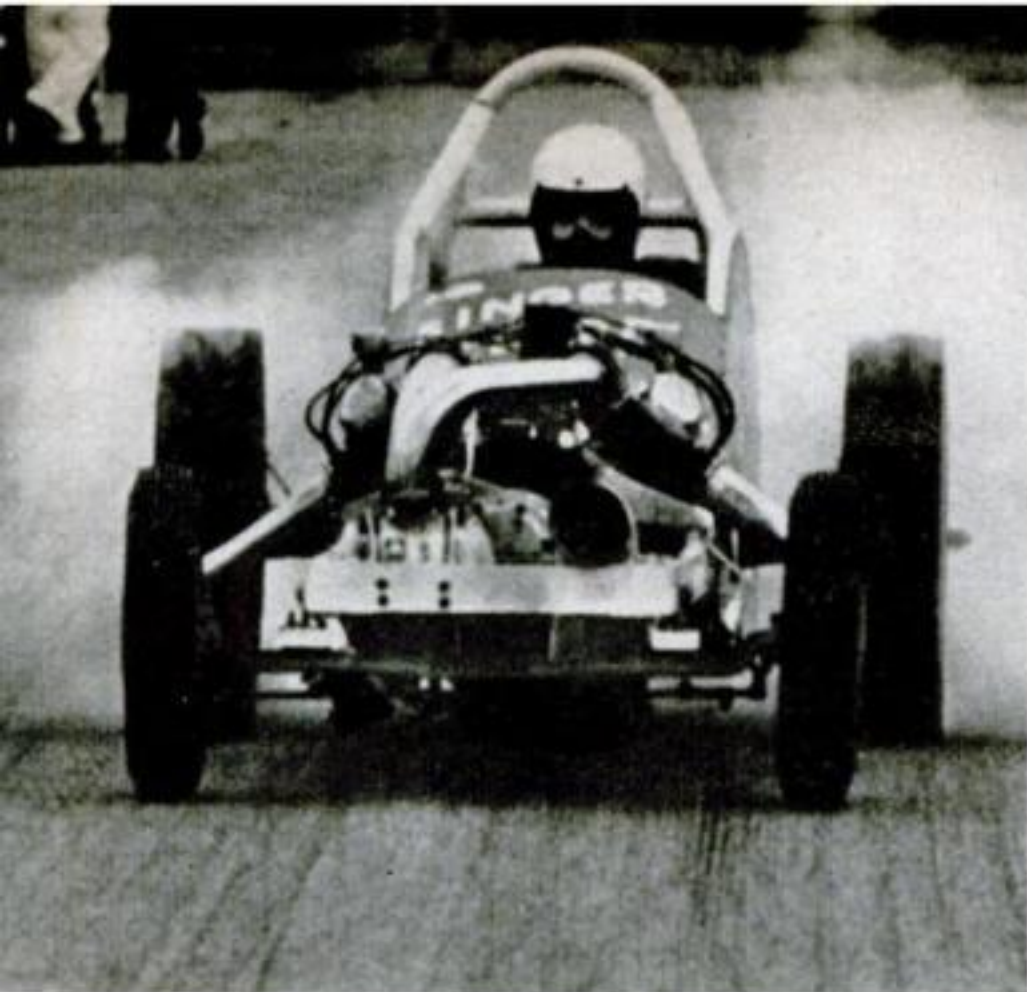


**You can rest your left foot** on a junked gas pedal that also actuates the headlight dimmer switch under slight additional foot pressure. Screw a wood block under the pedal to raise it to the height of the real gas pedal on the right.



**The rubber bulb** from a battery or anti-freeze tester can be put to other uses if the glass tube breaks. Cement a ¼"-diameter tube in a cork and press the cork in the bulb to make a dust blower or a syringe for adding water to the battery.





*All 5 top drag racers in '59  
used Champion spark plugs . . .*



*Every major U. S. outboard maker  
uses Champions.*



*All major power-mower engine makers  
use Champion spark plugs . . .*



*Over twice as many car makers  
use Champions.*

**Q.** Why do the experts, in field after field where performance is vital, use Champion spark plugs?

**A.** Because they know they can depend on Champions to deliver every bit of performance out of every drop of gas. Your car—or any engine you own—will start quicker, perform better and save on gasoline with new Champions. Put a new set in your car every 10,000 miles!

*Worn spark plugs waste lots of gas—  
so check your plugs every 5,000 miles!*

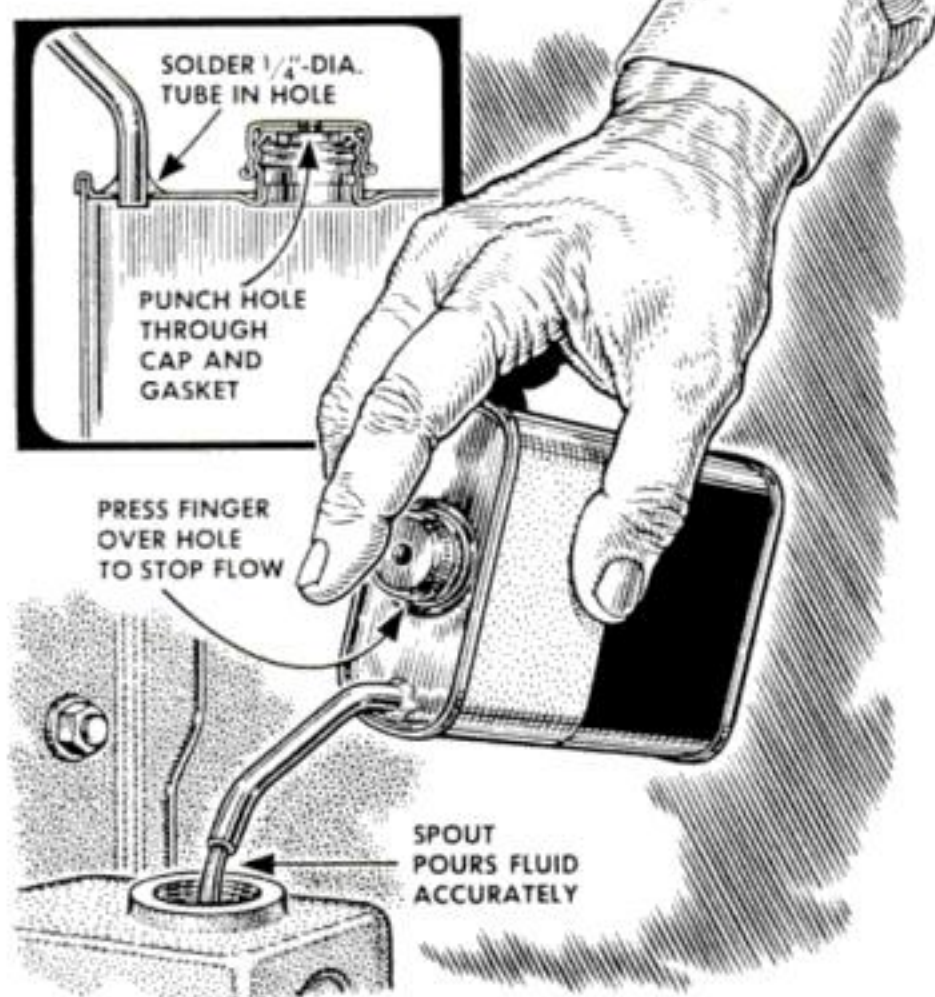
**CHAMPION**



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## More Hints from the Model Garage



A pouring spout of  $\frac{1}{4}$ " copper tubing soldered to the top of a clean pint can will help you avoid spillage when adding brake-cylinder fluid. Your finger over a vent hole in the cap controls flow. Use a different can for transmission fluid.



Plan ahead for roadside repairs by keeping a cut-down pair of work mittens with your tool kit. Worn upside down over your wrists as shown, the mittens will keep shirt cuffs and jacket sleeves from being soiled as you work.



When traveling, a roll of aluminum foil can be made into handy disposable dishes for feeding the dog and giving him water. Just mold it to the desired shape. In an emergency, the foil can be used to carry water to an overheated radiator.

## Do You Have an Auto Hint? Send It in and Win a Prize

HAVE you discovered or developed a money-saving short cut for making your own auto repairs? Have you found an easier way to do a difficult job? Got a tip that will make driving safer or easier? Or do you know someone who has?

POPULAR SCIENCE will pay a cash prize of \$15 for every auto-repair hint accepted for publication in "Hints from the Model Garage."

Describe your hint as completely as you can in words. Add a pencil drawing, or shoot a photo, if you feel this will make your idea more easily understood. Address your entry to Model Garage Editor, POPULAR SCIENCE, 355 Lexington Ave., New York 17, N. Y.

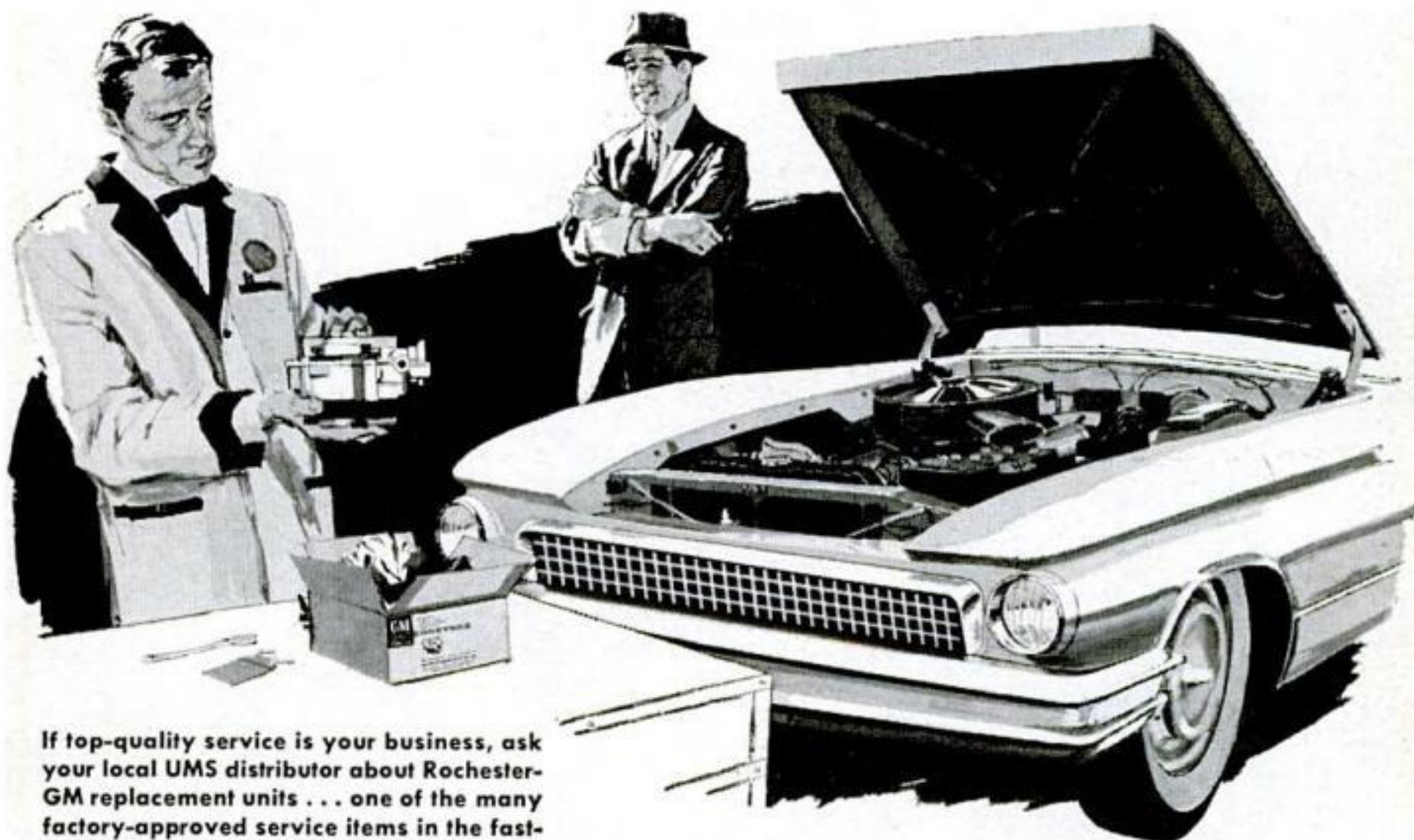


# MODERNIZE YOUR CAR'S **PERFORMANCE** WITH AN ORIGINAL EQUIPMENT CARBURETOR REPLACEMENT!

Available Now at Your Nearby Rochester-GM Carburetor Specialist's AT A NEW LOW PRICE!

When you need a replacement carburetor—see that it's a new Rochester-GM Carburetor . . . number one for original equipment. These replacement carburetors have the very latest engineering advances, giving your GM car up-to-the-minute performance. And they're at a new low price! They're engineered, manufactured and tested to the highest standards.

Rochester-GM Carburetors are original equipment on the new GM cars, including the new Corvair. Get a Rochester-GM Carburetor replacement for your GM car . . . update your performance and get new-car economy. Ask about it at your factory-trained Rochester-GM Carburetor Specialist's. *Rochester Products Division of General Motors, Rochester, New York.*



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America's  
number one  
original equipment  
carburetors

## ROCHESTER **CARBURETORS**





"This young fellow puzzles me," Corcoran told Gus. "I don't think he's lying, but I don't think he's telling the whole truth, either."





# Gus Teaches the Teacher

By Martin Bunn

**D**RIVING back from a turnpike call, Gus noticed a police car and three others halted at the widened approach to the toll booths. He showed his turnpike pass and drove on. With windows open to a bright early-summer day, he was enjoying the trip when a siren began to wail behind him.

Automatically his foot lifted from the throttle. But a glance at the speedometer showed Gus he was below the limit, and he planted his foot back on the gas.

The siren wavered as a police car shot by. With something of a shock, Gus realized that the trooper was waving him over. He slowed, rolled onto the shoulder. As the driver emerged, Gus recognized the smartly uniformed figure of Jerry Corcoran.

"Took a chase to catch you," growled the young trooper.

"I didn't think it was me you were after," Gus said.

"Well, it was. Gus, I've got a situation at the toll stop I want you to look into. I spotted you going by just too late, so I hared after you. Will you come?"

"Be glad to," Gus agreed. Moments later, following behind Corcoran, he was back at the toll area. Only two cars now stood there, the rear one with a smashed head lamp.

"Fellow in front says he slowed down for the toll," Corcoran told Gus as they walked over. "The woman behind claims he jammed on his brakes so hard she couldn't help hitting him. A third car hit her, did no damage, so I let it go."

"After hours of high-speed driving,

CONTINUED

185



their slow-speed judgment may have been off," remarked Gus.

"Maybe. But this young fellow puzzles me. I don't think he's lying, but I don't think he's telling the whole truth, either."

A TALL, red-headed young man strode toward them from the first car. "How about it, Officer? I'm the one who was hit. Can't I go on?"

"Pretty soon," said Corcoran. "How fast did you say you were going?"

"I dropped to 30 at the second toll sign, and wasn't doing more than 15 when she hit me."

"She says you stopped. Did you jam on your brakes?"

"No. Why should I?"

"How close was she?"

The young man looked uneasy. "Not too close. It wasn't her fault, nor mine. I had slowed down, and then picked up again, but my transmission downshifted suddenly by itself."

"Why didn't you say that before?" asked the trooper. "You know you shouldn't be on the turnpike with an unsafe car."

"But it's not unsafe," insisted the young man. "Not at ordinary speeds. It only does this under 20."

"You've just caused a three-car chain accident, luckily in slow-motion," said Corcoran. "Mind if this man checks your car?"

The driver offered no objection as Gus got into the car, a 1954 six-cylinder sedan. Backing slowly, he felt a sudden sharp catch in the power train. It wasn't repeated. He started forward. The car picked up smoothly to 20, then bucked as the transmission suddenly downshifted. Given more gas, it abruptly shifted up again.

On a second run the same thing hap-

pened, at lower speed. Gus parked the car.

"It downshifts abruptly at low speed," he told Corcoran. "The effect could be pretty much the same as if he'd slammed on the brakes."

Corcoran nodded and turned to the young driver.

"I won't give you a ticket, but you'll have to be towed off the pike and have this trouble taken care of within 10 days. Here's your warning. Gus Wilson here will tow you off."

The trooper stalked away. Gus looked

sympathetically at the disconsolate young man. "Where are you headed?"

"Just into the next town. I have an appointment with the school board at 3:15. Can I make it?"

Gus smiled. "You'd better. I know some of the board members, and they're none too patient. Look, I'll tow you right in at no extra cost."

WITH the sedan dangling from the wrecker's hook, rear wheels up, Gus and the young man headed toward town.

"Going to teach here?" asked Gus.

"Hope so. My name's Herb Findley. They're interviewing

me for a job to start next fall. But I hear this board has some old codger who's the last word on my subject, and if I don't rate with him, I'm out."

"That so? Who is he?"

"Never got his name. Say, would you look into this transmission trouble?"

"Sure thing," Gus said.

"Usually I do the simpler jobs myself," Findley said. "But I'm not eager to take down an automatic transmission, especially with school over."

"How's that?" asked Gus, turning into the Model Garage.

"Because during school I have equipment, repair manuals and follow-up serv-

### Where'd it come from?



STERLING: How "sterling" is sterling silver? Very. Legally the metal must be 92½ percent pure to merit the title. (The rest is copper—added as a hardening agent.)

The name itself may come from the "Easterlings," tradesmen from Germany who settled in England in the thirteenth century and minted coins of recognized fineness.



# "I 'built' my Chevy to be on call 24 hours a day."

"Ultra-high-speed turnpikes . . . chewed-up back country trails . . . I drive all kinds of roads in all kinds of weather. I doubt if anybody dishes out harsher treatment to a car than a country doctor like me. And I doubt if anybody depends more on that poor, overworked auto.

"So naturally I wanted a car that just wouldn't quit, no matter what. I settled on a Chevy right off, because of its taut body and rugged frame, among other things. For my money, you can't get a more dependable performer. Here's what I did with Chevrolet's whopping list of options to add up to just the car I was after:

"A Bel Air 2-door sedan, equipped with that tough six-cylinder engine and easygoing Powerglide\*. That power team's as rugged as they come, I'd say. Heavy-duty battery\* and generator\* next—I wouldn't even have known they existed till I saw that option list.

"And I really go for that Positraction rear axle\*. Brother, that's pulled me out of some mighty sticky spots. Then I picked the big heater\*, a radio\* and a spotlight\*. Say, that light sure comes in handy when I'm out in the hinterlands looking for a patient's house!

"Rugged? You bet it is—and I wouldn't swap my Chevy for anything. Easy to drive and solid muscled, and what M.D. could ask for more?"



Whatever sort of car you'd like your car to be, there's a Chevy package that'll fit you like a glove. Seven perky engines . . . five transmissions . . . dozens of comfort and convenience features . . . you've got some really pleasant choosing ahead of you. We'd suggest you start soon, with a trip to your Chevrolet dealer's. . . . Chevrolet Division of General Motors, Detroit 2, Michigan.

\*Optional at extra cost.

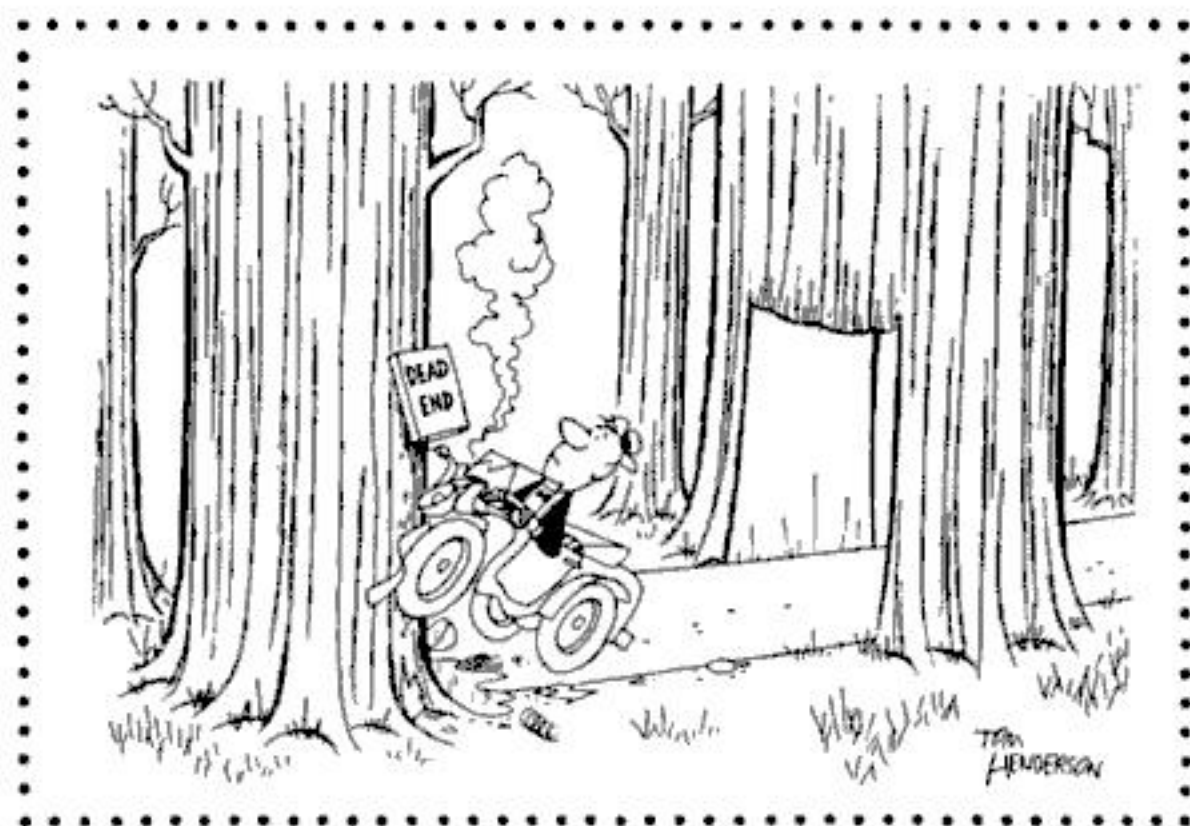
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ice bulletins. You see, I teach auto repair in high school."

**A**FTER making several checks without result, Gus wondered whether he shouldn't go back to school himself. The car shifted normally into high, downshifted smoothly on grades—and misbehaved staggeringly at low speeds. But the trouble seemed to occur at random. The electrical system and control linkage were faultless.

With the car on a body lift, Gus pondered: What, aside from some defect far inside the guts of the transmission, could make it downshift erratically?



"Stan!" Gus called to his assistant. "Hold that wheel while I turn this one."

Stan Hicks obediently locked on to one rear wheel while Gus turned the other against transmission drag. The drive shaft slowly spun around nine times. On the tenth it jammed, locking Gus's wheel.

"Let go!" he ordered, and the wheel Stan released turned backward as Gus spun his forward. The drive shaft stayed locked.

"Thanks, Stan. That'll do."

Removing the inspection plate that gave access to the shoes of the emergency brake on the drive shaft, Gus probed inside with two fingers. Both shoes were far from the drum; the hand brake was obviously overdue for adjustment. Seizing the drive shaft, Gus worked it back and forth. There was a clink of metal.

Inside the bottom of the brake drum,

he felt something turn under his fingers. With some difficulty he withdrew a steel nut.

"Where there's a nut," muttered Gus, "there's probably a lock washer."

He dredged the washer up after a little fishing. Then he pulled off the brake drum and replaced the wandering nut and lock washer.

**M**ORE cheerful than he had been on the turnpike, Findley turned up at the Model Garage well before closing.

"Get there in time?" asked Gus.

"Just. And they took me on. Seem as keen on teaching auto repair in the high school as I am."

"That old codger make any trouble?"

"No, he wasn't there. But they had a shrewd list of questions. Guess they got it from him. If so, the old coot knows cars."

Gus handed him a bill. "Yours is ready to roll—even on the pike. And I'm charging only for the tow. Fixing your downshift trouble is on the house. A nut and washer had fallen off inside the brake drum." Innocently, Gus said, "Wonder why that made the transmission act up?"

The young teacher frowned. "A loose nut inside the drum might jam between it and the shoes, if it happened to turn crosswise. That would put a sudden heavy load on the transmission, which would downshift to carry it, and squeeze the nut through. Soon as that happened, the transmission would upshift again."

"But only at low speed?" asked Gus.

"You're ribbing the teacher now! Is this right? At higher speed centrifugal force flattened the nut against the inside of the spinning drum and held it there, so it skinned by the shoes."

"You can go to the head of the class for that," chuckled Gus.

"I'm mighty grateful to you, Mr. Wilson. And glad that school-board expert didn't try to stump me with that one."

"Oh, didn't he?" asked Gus.

"Course not. How could he . . ." Findley paused, wide-eyed. "Not you?" Gus, the old codger, just grinned.



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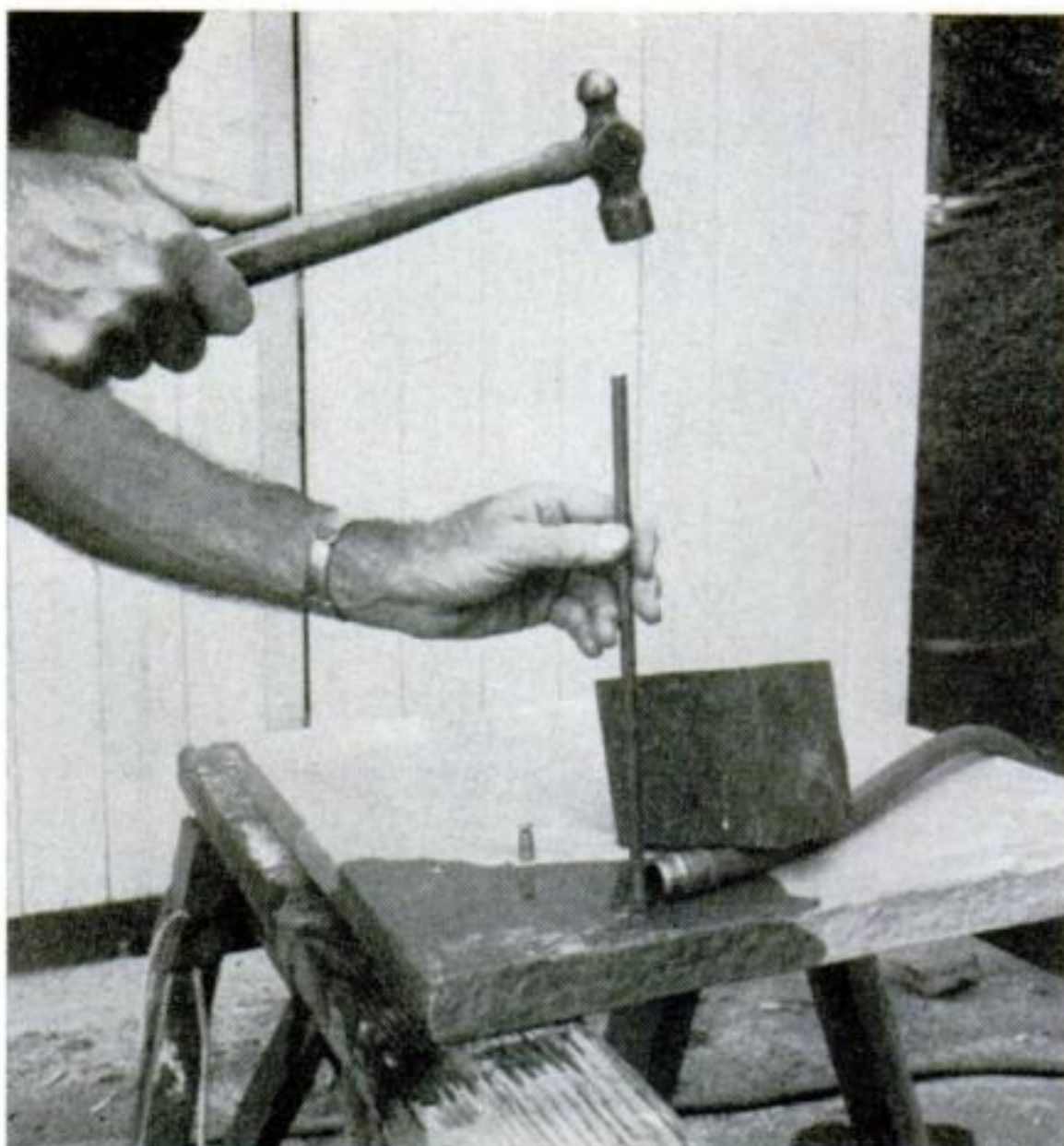


## Short Cuts and Tips

FROM PS READERS

### Running Water Aids Drilling

WHEN star-drilling holes in concrete or stone, use a stream of water from a garden hose over the work. It carries away dust and chips, keeps the drill cool to prolong cutting efficiency, and cuts down on vibration for a cleaner, more accurate hole. On flat work, the hose end can be weighted as shown in the photo to keep a light stream directed at the hole. On vertical surfaces, it can be taped in place above the work.—*Edward Munsey, San Francisco.*



▶▶▶WHEN we moved our refrigerator to a more convenient location next to the kitchen range, we noticed that the extra heat made it run too often. A piece of insulation board, slipped out of sight between the appliances, solved this.—*H. M. LeMunyon, North Industry, Ohio.*

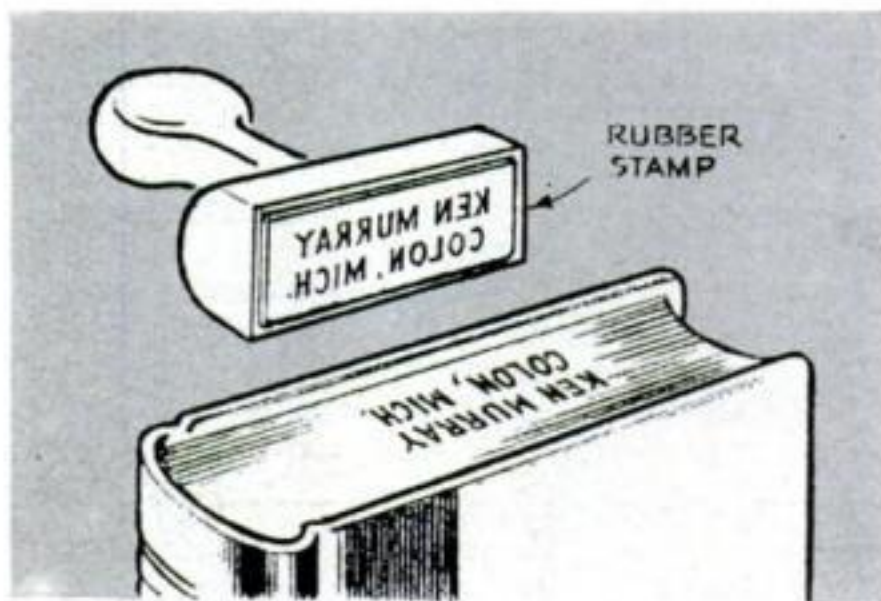
▶▶▶AFTER installing some glass-wool insulation without wearing gloves, I had trouble washing the needle-like fibers from between my fingers. I finally tried masking tape, pressing the adhesive side of the tape against my skin. That did it.—*Arthur T. Papke, Houghton, Mich.*

### Answer to the Apprentice's Switch Problem

[on page 124]

WHEN a split-phase motor is running, its starting winding is held out of circuit by a centrifugal switch. If the reversing switch is thrown quickly in the opposite direction, the running winding receives the same current. But as the centrifugal switch remains open, the starting winding receives no current, and the motor continues in the direction it is turning.

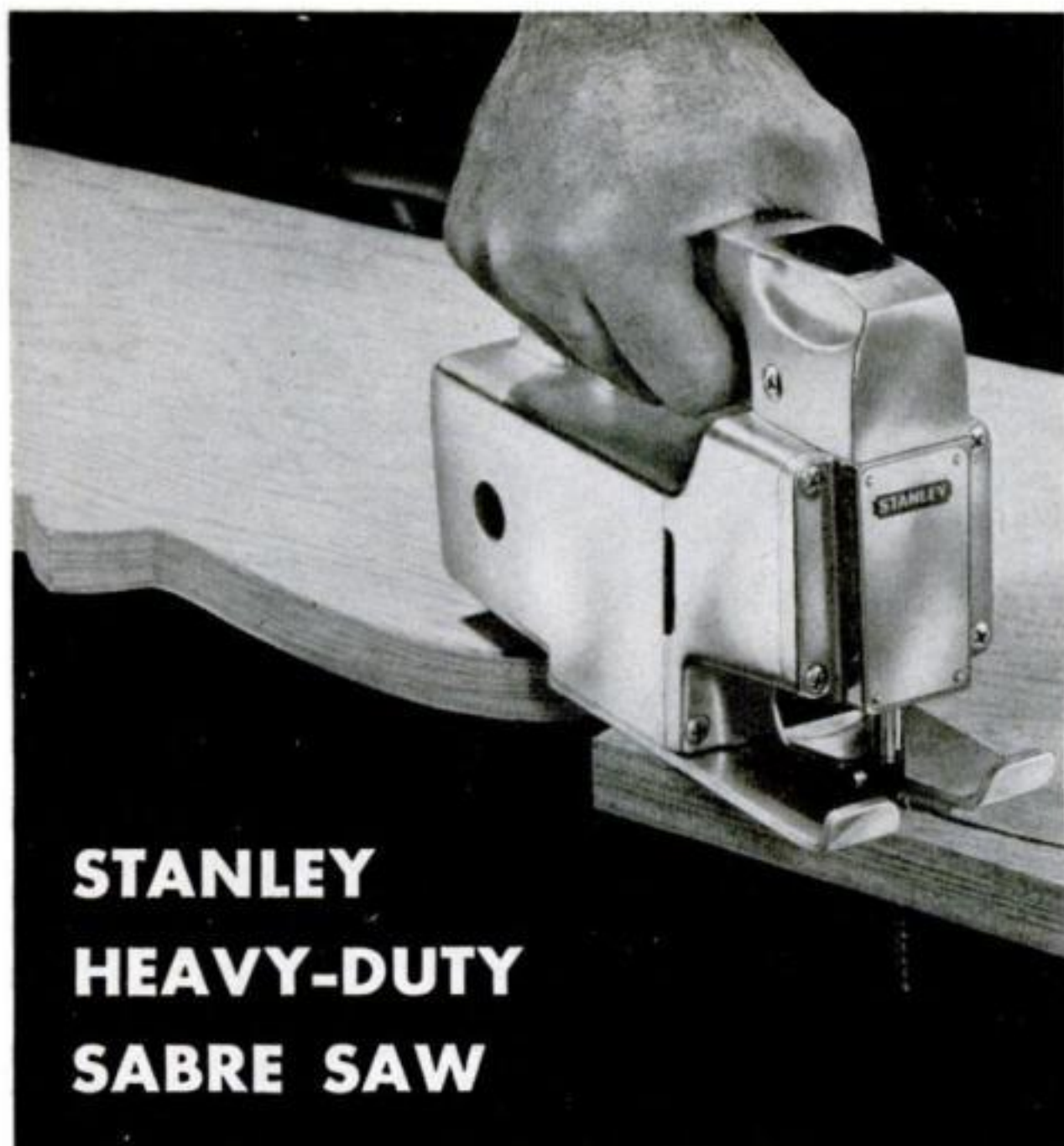
Direction of rotation is determined only at starting, by the phase difference between the two windings. Therefore the motor must come to rest, bringing its starting winding into circuit, before it can be reversed.



### Edge-Stamp Loaned Books

BRAND your books for quick return when loaned. Your name or bookplate on the flyleaf is easily overlooked, but if you use a rubber stamp to imprint both name and address on the edges or ends of the pages, the exposed reminder assures a prompt return. For a legible imprint, press the book covers firmly together.—*Ken Murray, Colon, Mich.*





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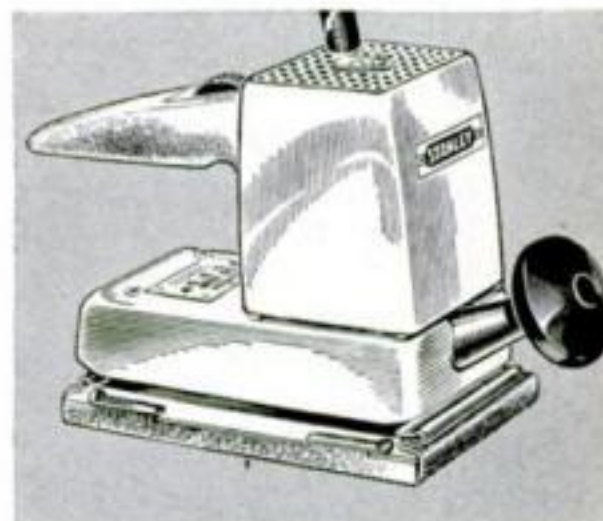
Includes saw, 8 blades and ripping guide in sturdy metal carrying case.



H31 belt sander rough-sands, finishes wood, metal and plastic. \$89.95.



Save up to \$15 on Stanley builders saws, kits. Offer ends July 31, 1960.



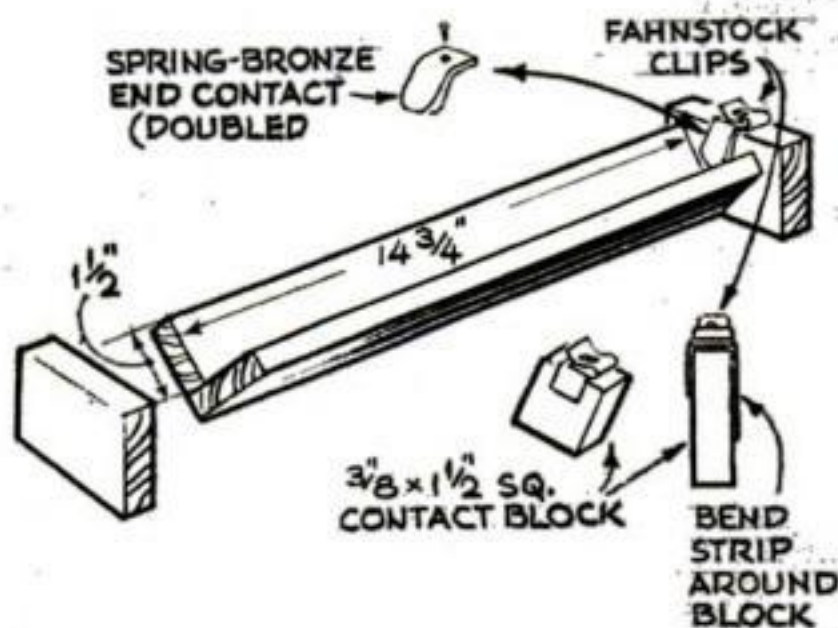
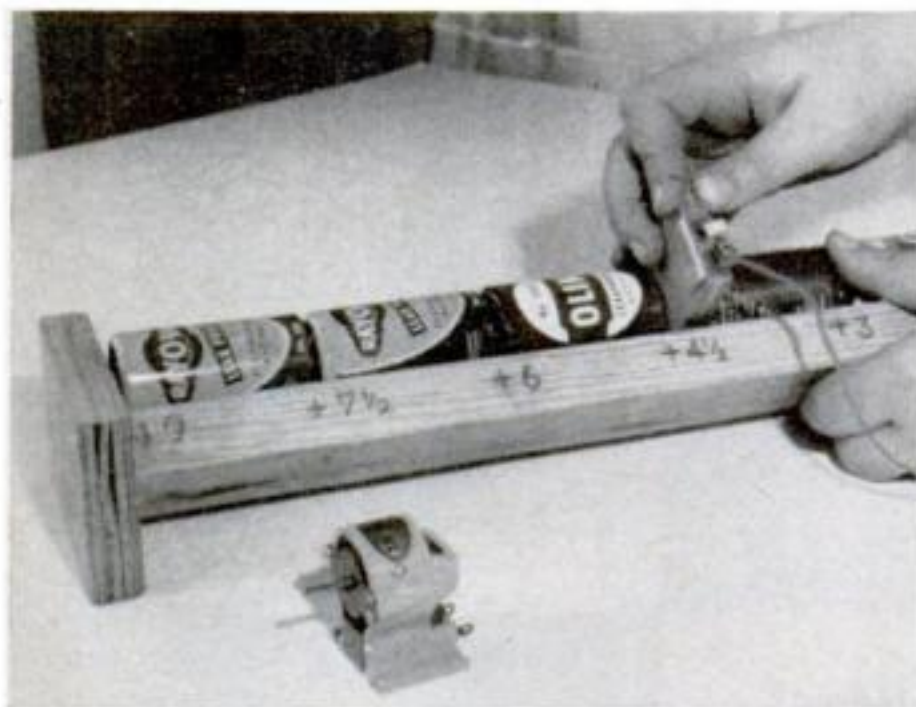
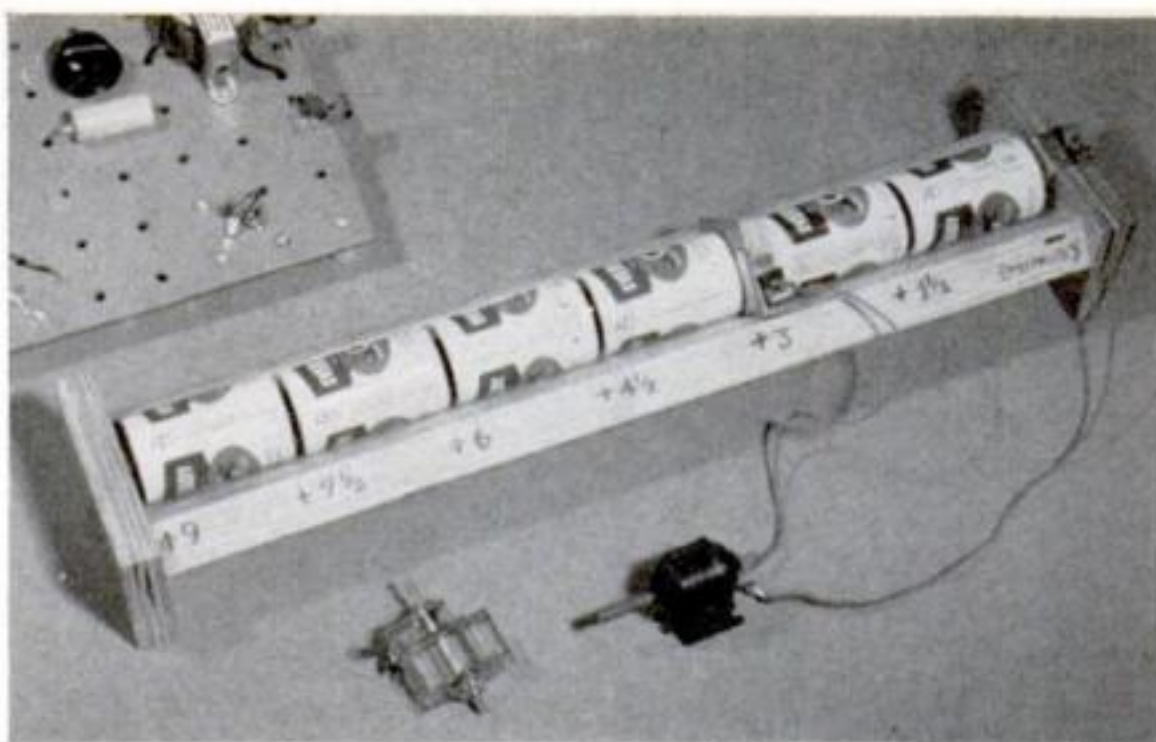
H36 orbital sander ideal for small work areas, flush sanding. \$49.95.



## Short Cuts and Tips

FROM PS READERS

**FACE ALL CELLS** the same way, bottom toward the end contact. Mark voltage steps on one side of the rack to show where to insert the contact block. Use out-worn cells to fill out the rack when only low voltage is needed.



### Handy Battery Rack Gives a Choice of Six DC Voltages

HERE is a convenient power source for testing permanent-magnet motors, model-railroad equipment, radio-control accessories, and transistor circuits. It can deliver  $1\frac{1}{2}$  to nine volts from ordinary D cells in  $1\frac{1}{2}$ -volt steps.

Nail the two lengths of wood together at the edges. Attach two end blocks, bottom edges parallel, to make the rack stand firmly.

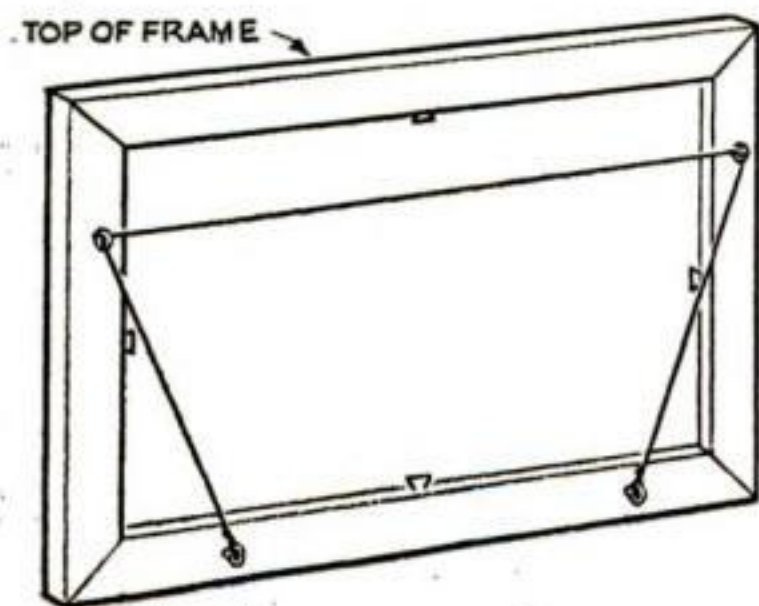
Cut a 3" length from bronze weatherstripping, and fold it double. Screw this

to an end so that a D cell in the rack will make contact. Bend another piece of metal around a  $\frac{3}{8}$ "-thick wood block as shown. Mount a Fahnstock clip under one screw of each contact.

Slide the cells apart to insert the movable contact where it will deliver the desired voltage. If low voltages are more often used, rotate the cells to even out wear. Higher voltages can be obtained by extending the length of the rack.—*Harry Walton, White Plains, N. Y.*

### Hanging a Loose Picture Frame

IF YOU don't trust the loose joints of a picture or mirror frame you must hang, attach the hanging cord as shown and the frame will stay safe and sound.—*Harold R. Terpeny, Marion, Mass.*



▶▶▶ CARDBOARD cartons used for carrying six bottles of soft drinks are just as useful for carrying or storing baby-food jars, or as a holder for jars of screws and other small hardware in the home workshop.—*John Mihalick, East Liverpool, Ohio.*



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No. 800-8¼"	2⅞"	2-9/32"	2.0 HP	\$95.00

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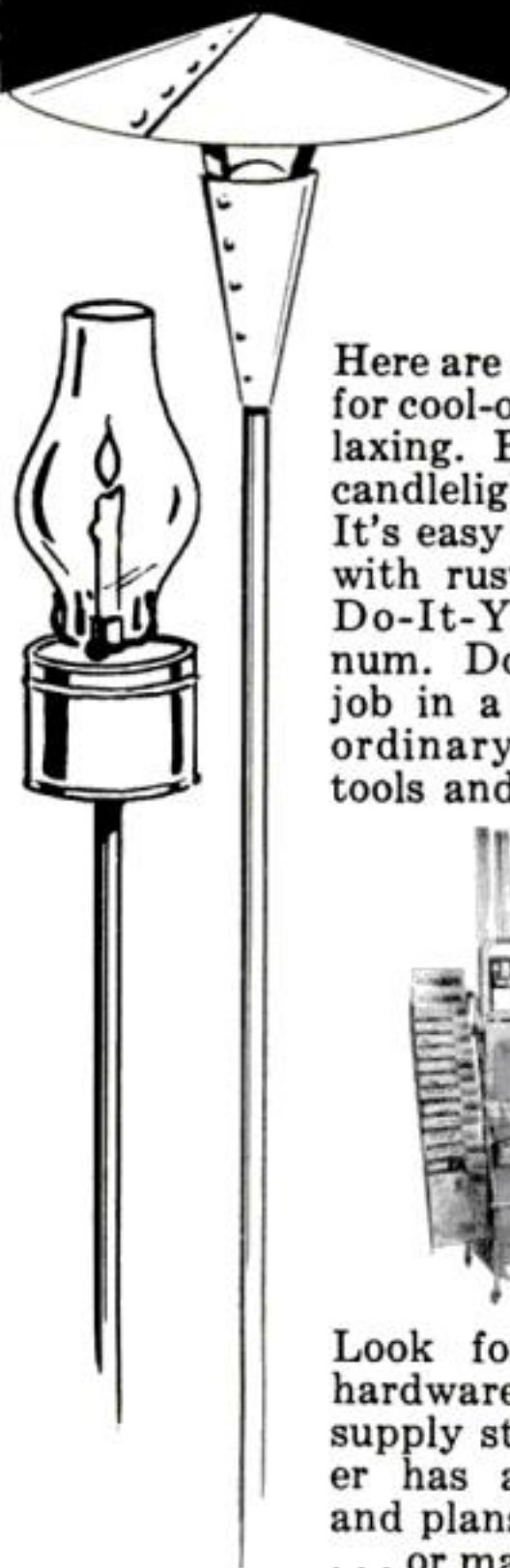
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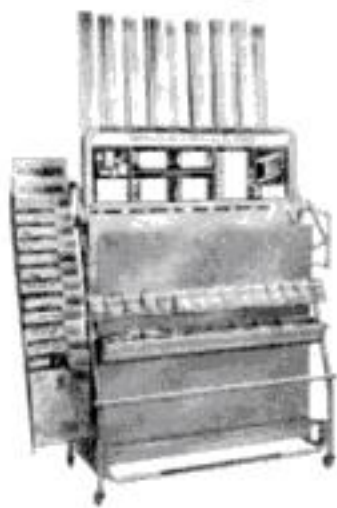




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Dept. PS

## Who Says Bikes Are for Kids?

[Continued from page 49]

men and women of all ages who were spinning about on bicycles.

"Finally," said the husband, "we rented two bicycles and spent a week riding from village to village in northern Holland. It turned out to be the high point of our vacation."

Since then I've discovered that Americans seem to be getting back to the bike for all sorts of reasons: to go trout fishing, shopping, bird-watching, sketching, and sight-seeing. Some who live in hilly regions or in big cities purchase folding bicycles which they can carry with them on weekend trips.

Cycling, I've learned, is making its strongest gains on college campuses. A recent survey revealed that the University of Michigan has 4,500 student bicycle owners, the University of Florida 3,200. College authorities predict that soon the bulk of the U. S. college student population will be mounted on bikes as cars are banned to undergraduates to reduce campus traffic jams.

Thousands of young people are members of the American Youth Hostel Movement, which sponsors hostels where cyclists can obtain food and shelter at low cost. In many parts of the country local youth-hostel councils schedule regular cycle tours over secondary roads in scenic regions.

**Rx: bike-riding.** No group in the nation is happier about the revival of cycling than the nation's doctors. Many of them see it as an ideal means of combating the tensions and diseases associated with our chairborne, high-caloried, pushbutton existence. The most vocal and determined crusader is President Eisenhower's noted heart consultant, Dr. Paul Dudley White, who doesn't let a day go by without passing out a prescription for more bike-riding to some individual. He himself has been hopping on and off bicycles ever since his New England boyhood some 60 years ago.

According to Dr. White, the threat of future ill-health applies particularly to middle-aged men and women, and to children. "Boys and girls in the United States are not getting the simple everyday exercise they used to get walking to school, running errands, roller-skating, and riding bicycles," he said. "Nowadays

CONTINUED



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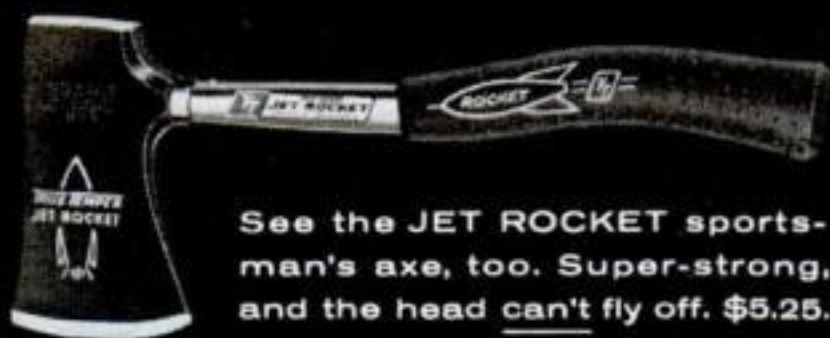


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## Who Says Bikes Are for Kids?

they spend a great deal more time just sitting—in the family car, in buses, and in front of television sets. One of the saddest sights I know of is a school bus crammed with children on a sunny afternoon. I believe the cycle is the answer for all of us—from age four to 80. Pedaling a bicycle exercises virtually every muscle in the body, yet it is not exhausting. If we could make a bicycle ride a routine part of our everyday life, we would have taken a vital step toward restoring health and vigor in us all."

*But make it safe.* Dr. White is the first to insist that before cycling becomes more popular it must be made much safer. Nothing incenses him more than the fact that the current multibillion-dollar national highway program does not provide a single cent for separate cycle lanes such as those that protect the biking populace in many European countries. He now heads a Committee for Safer Cycling composed of other physicians, lawyers, college professors, journalists, and businessmen who are out to do something about the way the cyclists have been driven off the highways and byways of our nation.

As a result of the Committee's effort, Massachusetts is the first state to appropriate funds to make cycling safer. An eight-mile cycle path is under construction on Nantucket Island, where as many as 1,500 bikes are rented to vacationists on a busy summer weekend. The Committee's next project is to raise funds for a cycle path along Boston's Charles River so people can cycle to work.

Across the nation, many communities and cities may soon follow suit. Chicago has set aside cycle paths in 27 city parks and is planning more lanes throughout the metropolitan area. State and national park commissions are considering ways of providing more cycle paths. In thousands of communities, police officials, educators, and civic groups are campaigning to make cycling safer.

Nowadays, when the bundles are heavy, the snow flies, the rain falls, or night descends, I am grateful for the solid comfort of the automobile. When long journeys are called for, I welcome the train and the airplane. But the rest of the time, to remind myself I am alive, I'll stick to the bike.



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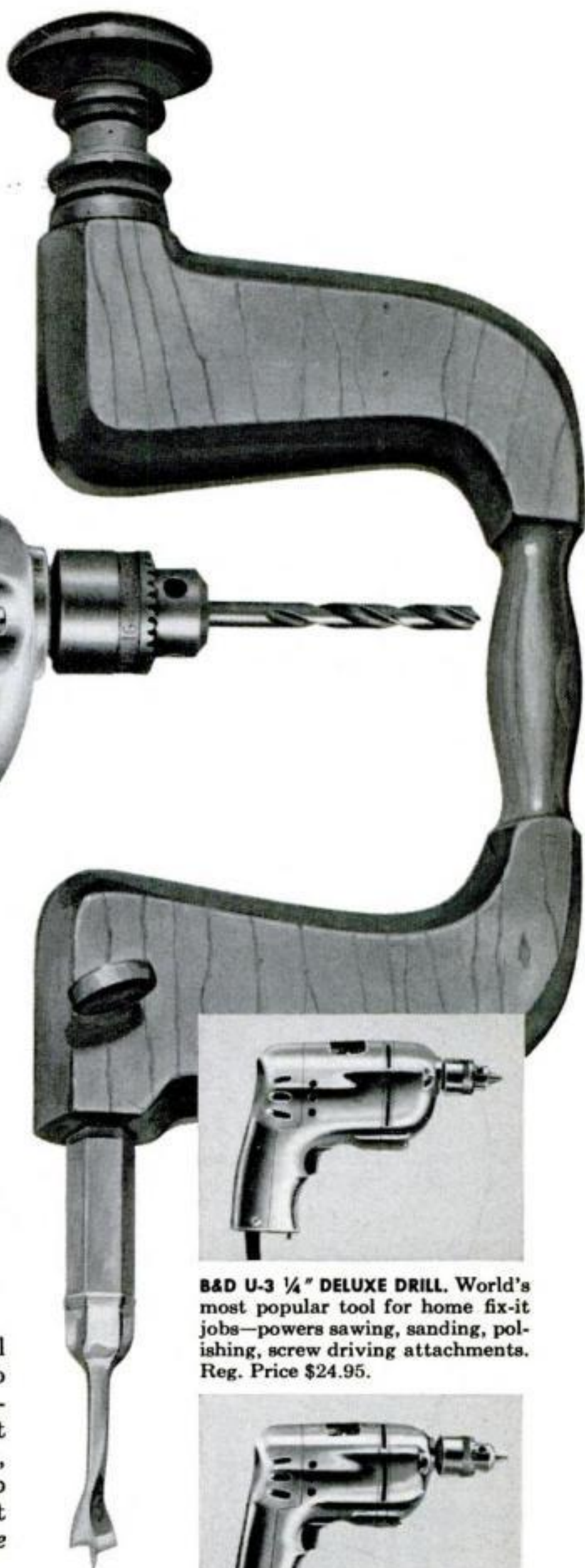
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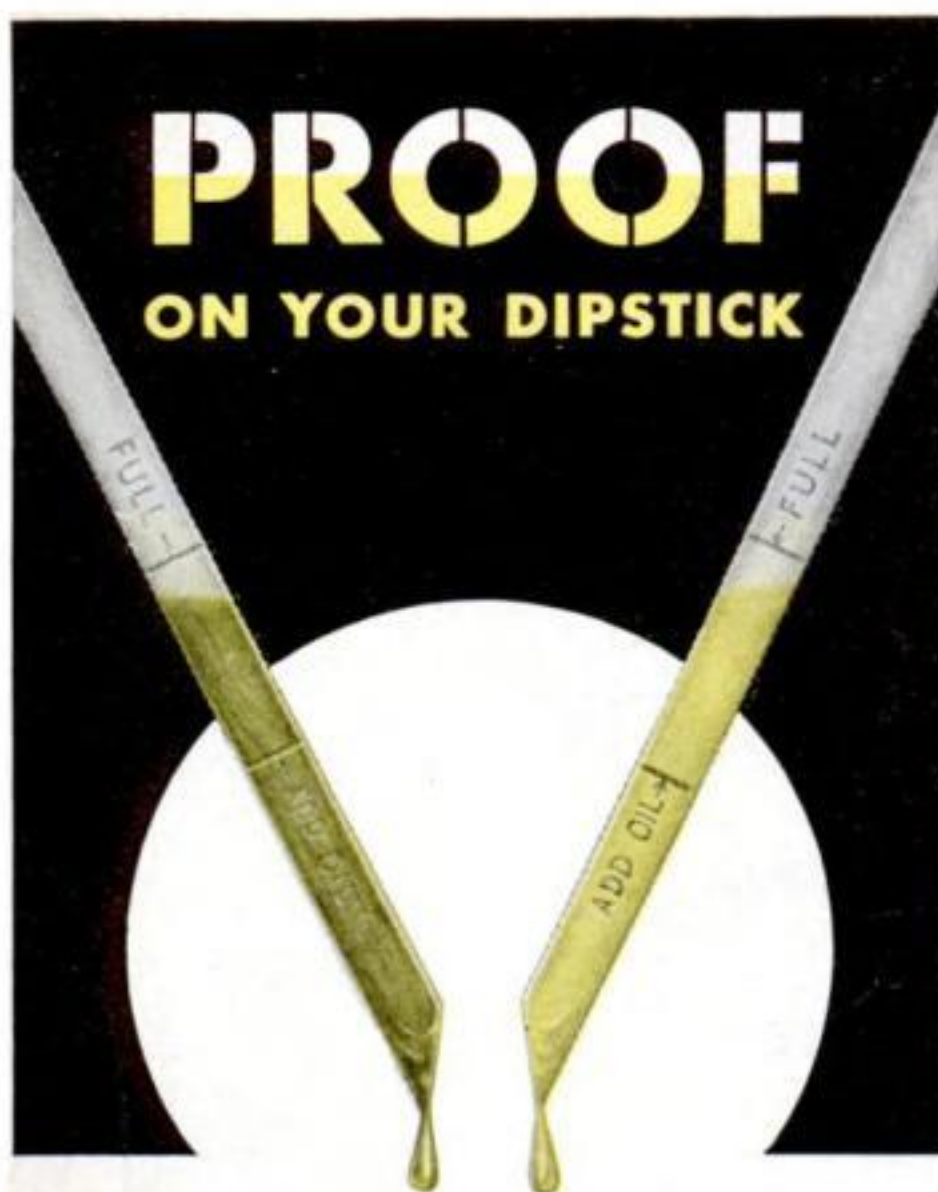


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Spark Plugs

## Lazy Man's Lawn-Keeping

[Continued from page 177]

it equals days of digging plantains, dandelions, and chickweed by hand. For crabgrass, remember that the standard killers don't work on broad-leaf weeds.

## Save your energy on seeding

Summer is now upon you. If you failed to seed at the proper time, it's too late for perennial turf. Many a man complains of spending hard money on seed in June, only to reap a crop of weeds in August.

Of course he did! Over most of the bluegrass belt, a lawn started in summer has to fight weeds that already have established squatter's rights.

Relax. Chuck in some seeds, such as Korean lespedeza, for a temporary cover. Then wait until fall to sow a permanent bluegrass-fescue mixture.

Now let's jump ahead a few months on your lazy man's lawn. It's fall. It's cool. This is the time when you really get in your licks for a lazy summer next year.

Take it easy in preparing your soil. The more soil is whipped and fluffed, the less life it has. Pulverized soils slake to a muddy, impenetrable crust upon watering. Rain doesn't soak in. No air reaches seeds. Seedlings can't poke through.

The best way to prepare your soil—with the least work—is to use a good power tiller. These dig, rather than fluff, the ground. Or have a landscaper disk the ground with a tractor. If you insist on the alternative, spading, leave the surface rough.

In frosty climates, a soil that leveled in the fall will loosen internally during the winter just from freezing and thawing.

Do not work heavy soils when wet. They will only compact.

Roll lightly, if at all. The home owner who cultivates his soil, and then rolls it, is only doing work and then undoing it. Rolling mashes the soil down. Compaction makes it less receptive to water. If you roll, do it just to point up spots that will sink.

## Topsoil? Tsk, tsk!

Many a fine lawn has sprung from subsoil that originally couldn't support cactus. Plenty of fertilizer does the trick.



### **Lazy Man's Lawn-Keeping**

Grass then progressively enriches its own topsoil. Bought topsoil is expensive. Worst, often it's of questionable quality. You want to take it easy next summer? Then remember that topsoil frequently is full of weed seeds.

Manuring is expensive. Applying it is hard and distasteful work. Manure is apt to be weedy. Better to spend your money on sacked fertilizer, and let the grass roots grow your humus.

Grass regenerates about half of its roots each year, working the humus among the soil particles. Sacked fertilizer—and here's another work-saver—is applied easily with a mechanical spreader.

The lazy (and smart, by the way) lawn-keeper seeds in the fall. That is, for most parts of the U. S., using bluegrass-red fescue.

He also saves himself work by picking his seed. Don't grab the cheapest box of seed on the shelf. Yes, it will green-up fast. It will look good. And much of it will die the first year. What lives will resemble a hay field. That's because the cheap seed package contains a high percentage of coarse haygrasses. They're as tough as weeds.

Retain your professional standing among lazy gardeners by consulting your garden center on seed. Read the ingredient listing on the package carefully. For states from Tennessee north, the package should contain a high content of Kentucky bluegrass and red fescue. For the South, Bermudagrass is a good buy. Good seed will provide a perennial turf that should last indefinitely and save you work.

### **Free mulch**

Once you've seeded, mulch. A thin mulch layer—straw, sphagnum, Erosion-net, even grass clippings from another area—will hold moisture in the soil. This will encourage quick sprouting. It also will protect the seed from downpours that might wash it away. There's a dividend, too—less need for sprinkling.

Finally, let that brown crabgrass be. The seeds already have matured. Tearing out the dead crabgrass will succeed only in spreading them. They are next year's headache. Besides, digging out dead crabgrass is work. And, left where it is, it makes a fine mulch.

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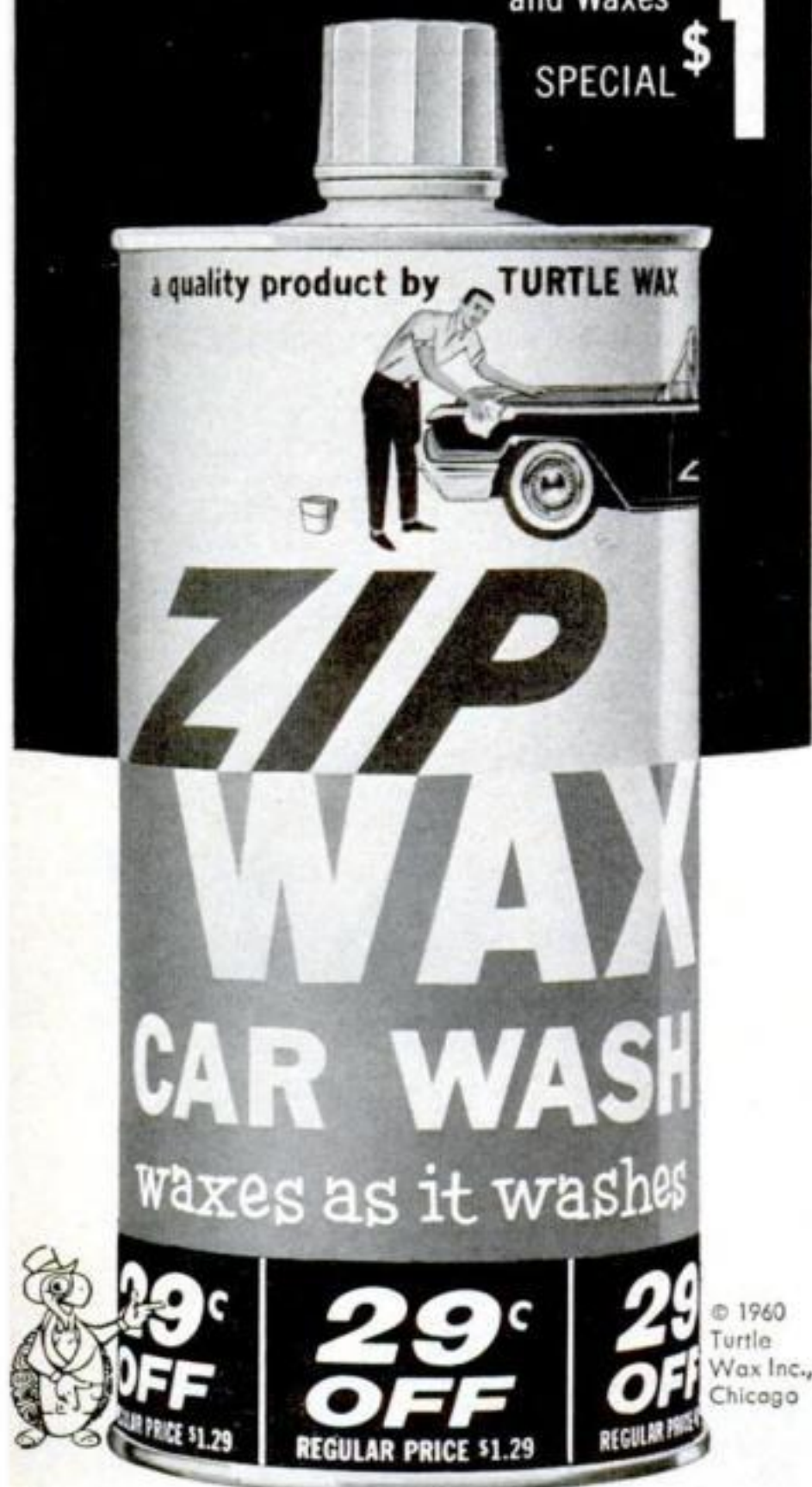


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### The Truth About Spark Plugs

[Continued from page 46]

can happen in brand-new cars, often coming on quickly. Lead fouling is insidiously difficult to spot. In fact, one research study reports that even trained observers didn't spot this type of misfiring until it exceeded 12 percent of the time. It is *not* the regular, rhythmic "miss" that comes when a plug wire, say, is pulled off, but is a much more subtle trouble.

- It happens mainly at high speeds when spark-plug ceramic temperatures are highest.

- It occurs mainly after a period of low-speed, light-load operation.

- It is a random, transient occurrence.

Almost all gasoline today—regular as well as premium—has tetra-ethyl lead added to it to raise its octane rating. During low-speed, light-load driving, when spark-plug ceramics are relatively cool, deposits of lead compounds accumulate on the insulator nose. Because they don't conduct electricity when cool, they are largely harmless at low speeds. But at high speeds, when temperature goes up, the electrical resistance of the deposits drops. They become good conductors, causing the plug to misfire.

Knocking such as you might get on a hill brings a sharp rise in plug temperature, causing severe misfiring. But note the insidiousness: When a cylinder fails to fire, the plug begins to cool. When the temperature drops, the resistance of the deposits rises and again allows the plug to fire.

Lead fouling can be relieved somewhat by a phosphorous additive in the gasoline. The additive does not remove the deposits, as sometimes suggested, nor does it prevent their formation. What happens is that they are changed chemically to compounds having somewhat higher electrical resistance. The new compounds are still sensitive to spark-plug temperature but the trouble ranges are higher.

**Hot sparks and cold facts.** Automobile mechanics know that a wide plug gap will often give a smooth idle. They also know that if you get it too wide, the engine will misfire at high speed, when the voltage available drops below the voltage required to fire the plug. Test reports also show that wider gaps give better slow-speed gasoline mileage. One report indicates a marked fuel-mileage gain in

CONTINUED



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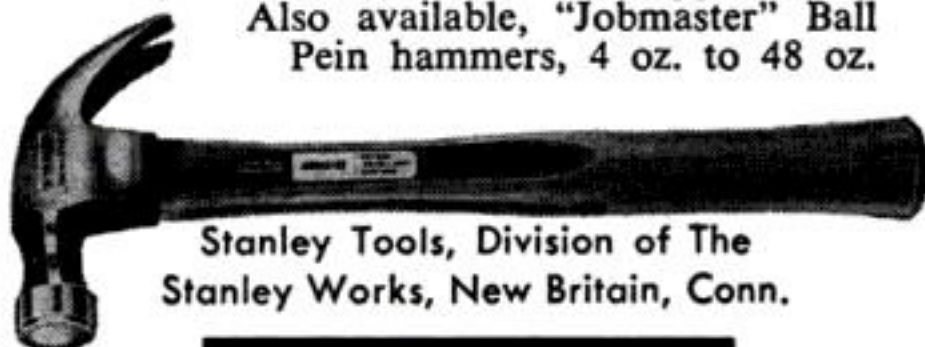
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### The Truth About Spark Plugs

going from a .025- to .035-inch gap, a slight gain when the gap was increased to .040, and practically no difference beyond .045. At speeds above 50 m.p.h. it made almost no difference—in mileage—whether the gap was .030 or .060.

Engineers explain these curious findings this way: At part throttle, conditions often cause varying inflammability of the incoming charge. You may get a lean fuel mixture, or partial dilution with exhaust gases, or a stratification of the charge from insufficient turbulence. Now, with a standard plug, a longer spark has more heat energy, lasts longer, and includes a larger sample of the fuel mixture in the gap. All these factors increase the probability that a self-sustaining fire will be started in the cylinder. The gasoline economy comes from eliminating random misfiring.

So a spark-plug design that would give a longer spark at lower voltage seems attractive at first glance. This is in fact the claim made for the surface-discharge plugs. As far as the physical measurements between the electrodes are concerned, it's true. The separation is about .060, compared with the .035 typical with standard plugs. The voltage requirement under normal driving conditions is not significantly different.

But this immediately raises a nice question—how is the energy in a spark related to the voltage? If you open up the gap of a standard plug, it requires a higher voltage to fire. So then there is more energy in the spark. But if you simply stretch out the spark without giving it more energy, what is gained?

It might be argued that a longer spark exposes the spark to more fuel molecules. But since the spark is along a surface instead of in the open, the fuel is exposed to only one side of the spark. It would also seem that the insulator, being in close contact with the spark, would rob the spark of some of its heat energy.

Theory aside, what counts is whether the surface-discharge plugs perform the miracles claimed for them. I tried them in my own car for 5,000 miles, keeping careful records of fuel mileage and performance before, during, and after using them.

The results: There was no difference in gasoline mileage. There was no differ-

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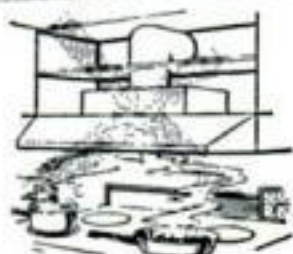


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### The Truth About Spark Plugs

ence in engine octane requirements. There was no difference in performance.

**Hot and cold plugs.** For a long time now, spark plugs have been made in various heat ranges. Heat range is still one of the least-understood factors in spark plug operation. But as engines have become more powerful (and more finicky), heat range has become increasingly important.

For satisfactory plug life and engine operation, the insulator tip should remain between 900 and 1,700 degrees. Below 900 the plug is apt to foul. Above 1,700 degrees it may bring pre-ignition. An ideal spark plug would always operate within this useful range. You buy hotter or colder plugs solely to keep the insulator temperature correct.

Technically, it is an engine that is hot or cold, not its plugs. A hot plug conducts heat away from the insulator tip slowly. A cold plug transfers heat more rapidly. In a particular engine at road load, a hot plug may reach proper operating temperature at 20 m.p.h., and approach pre-ignition temperature at 50 m.p.h. In the same engine a cold plug might remain in

the fouling region up to 35 m.p.h., but not reach pre-ignition temperature until a sustained 80 m.p.h. Obviously, the best choice is a plug that remains in the safe zone in the commonest type of service.

**Projected-nose plug.** This is the latest thing for high-compression OHV engines. It uses conventional spark-plug parts, but is designed so that the insulator tip and the electrodes extend beyond the end of the shell—protruding into the combustion chamber. The long insulator nose slows down heat transfer, which allows the tip to heat up quickly at light loads. But at high speed it doesn't get as hot as conventional plugs because the high velocity of the incoming rich fuel mixture cools the tip. Thus the range of acceptable insulator temperatures is extended both ways.

Despite the best efforts of engineers, spark plugs still require regular attention. Electrodes wear away and harmful deposits accumulate on the insulator. Plugs must be cleaned every few thousand miles, and electrodes filed and gapped. When the electrodes are too worn to obtain an efficient gap, you need new plugs.



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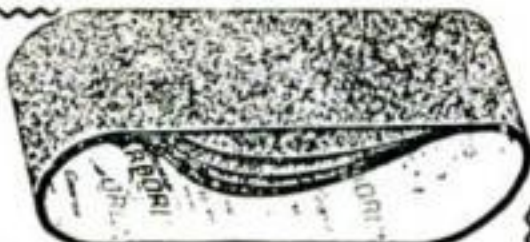
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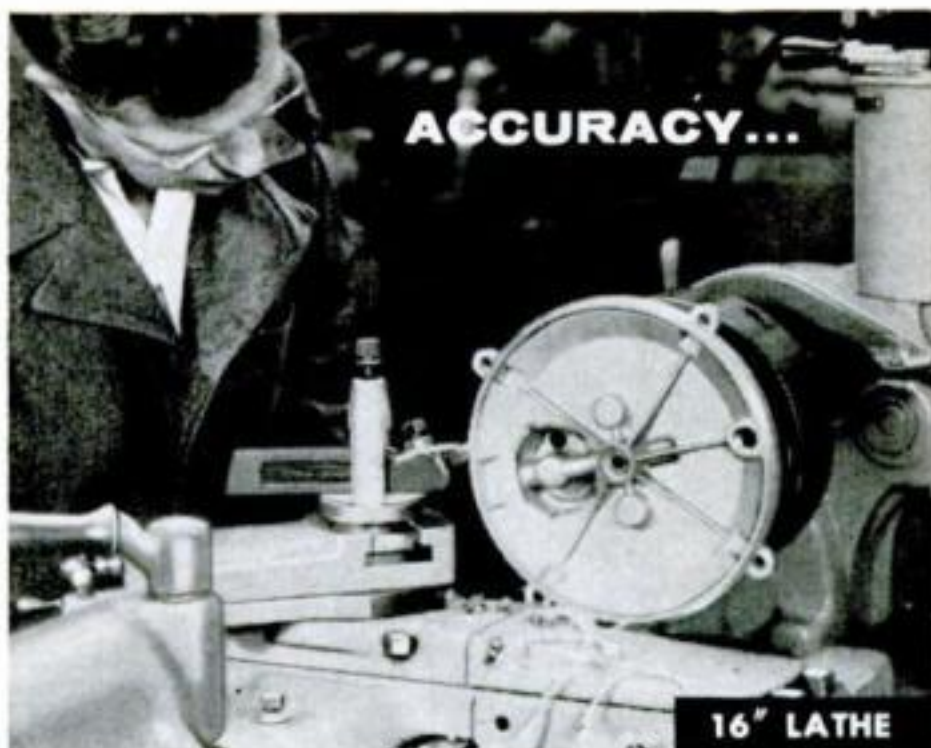
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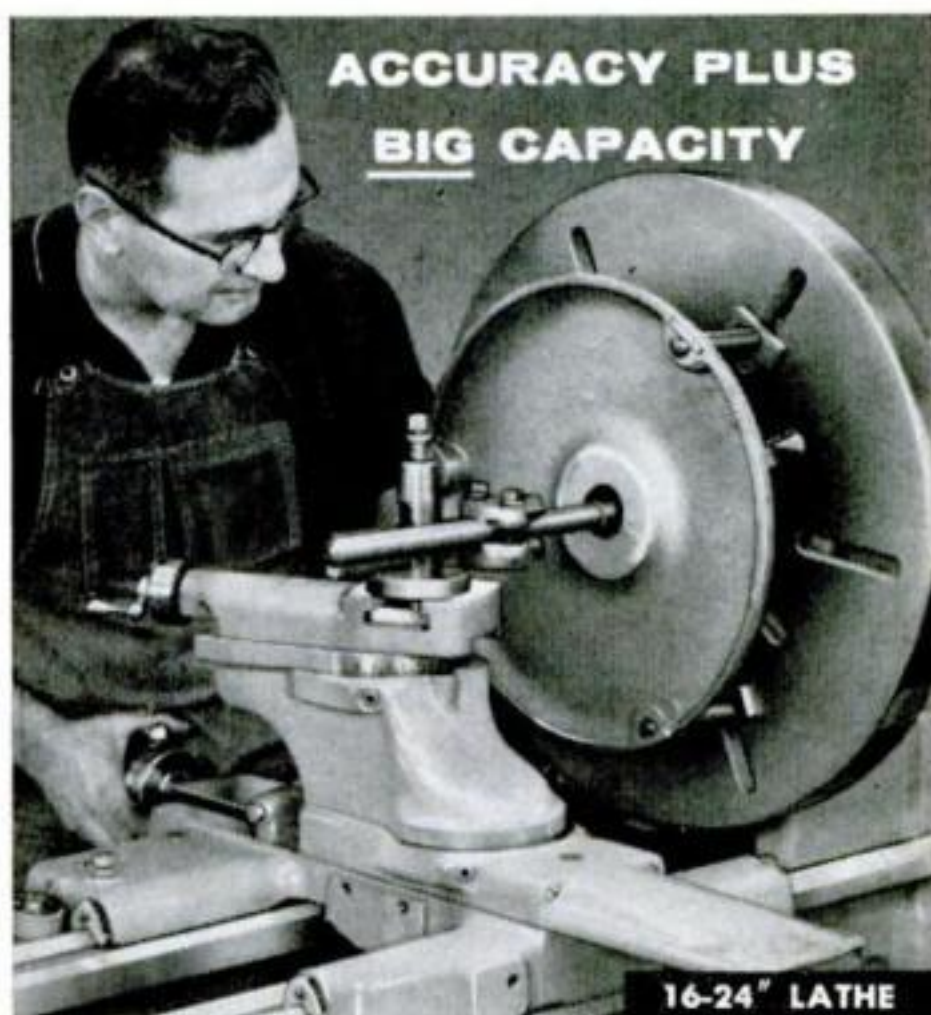
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## Answers to

## PS Puzzlers

on 18 and 20

**Parking-ticket odds:** The prof should rent a garage for those two days. The probability that the 12 tickets came on Tuesdays and Thursdays just by chance is practically nil.

Set down, at random, 12 different days of the week. One arrangement might be:

M Th F W Sa F M Su W F W Tu

Now look at it. In every place in that arrangement you had a choice among seven different days. And each choice can be combined with seven possible choices for every other day of the 12, yielding, in all, a number of possibilities totaling  $7 \times 7 \times 7 \dots$  etc., on up to  $12 \text{ } 7\text{'s}$ . But suppose you were limited in your 12-day arrangements to Tuesdays and Thursdays. Now the 12-day possibilities are only  $2 \times 2 \times 2 \dots$  etc. Dividing the professor's Tuesday-Thursday actuality by the seven-day possibility yields the fraction:  $2^{12}/7^{12}$ . So the probability of the tickets coming accidentally on Tuesdays and Thursdays is 0.0000003. Very small indeed.

In the variation, the probability that no tickets were given on Sunday is  $6^{12}/7^{12}$ . This is about  $1/6$ —too high to draw any conclusions about the cops having Sunday off.

**Geometric puzzle.** The fallacy is that the parts don't really make a perfect rectangle. The diagonal of the rectangle is not a straight line—the angles of the trapezoid and the triangle which seem to form it are not equal.

**Monkey puzzle.** The weight moves up, too. The forces on either side of a simple frictionless pulley are balanced. A new force—the monkey's climbing effort—exerted on one side of the pulley is transferred without loss to the other. In effect, the monkey climbs the rope and pulls the weight up with him.

**Five cows.** Let  $x$  = new grass that grows in a week on one acre. Then the grass that 3 cows eat in 2 weeks is 2 acres +  $4x$ . Thus 6 cows would eat that much in one week, each getting  $\frac{2a + 4x}{6}$  worth.

Similarly, 2 cows eat 2 acres +  $8x$  in 4 weeks' time; 8 cows could knock that much off in a week, each getting  $\frac{2a + 8x}{8}$  worth.

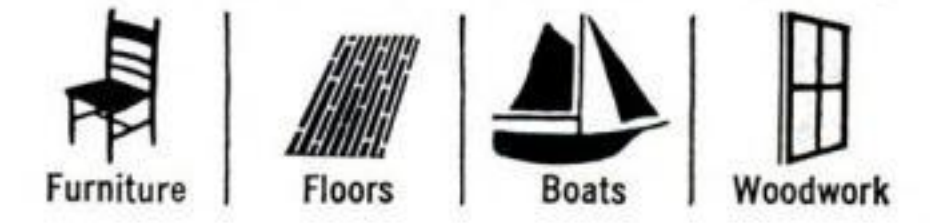
But appetites are equal, which means the two fractions are equal. So  $x = \frac{1}{4}$  acre.

That means that in 6 weeks 6 acres will have added 9 more acres of new grass—all told 15 acres to be disposed of. One cow eats  $\frac{1}{2}$  acre a week (you can get that by substituting  $\frac{1}{4}$  acre for  $x$  in the fractions) or 3 acres in 6 weeks. So 5 cows polish off all 15 acres.

**Mirror puzzle.** The bandit was a southpaw. If the customer saw the barber sign backwards, it must have been reflected by both mirrors. A window sign reads in reverse from inside. A single mirror would turn it right-side-to; double reflection would reverse it again. If the customer saw the bandit twice-reflected, the gun was in his left hand.



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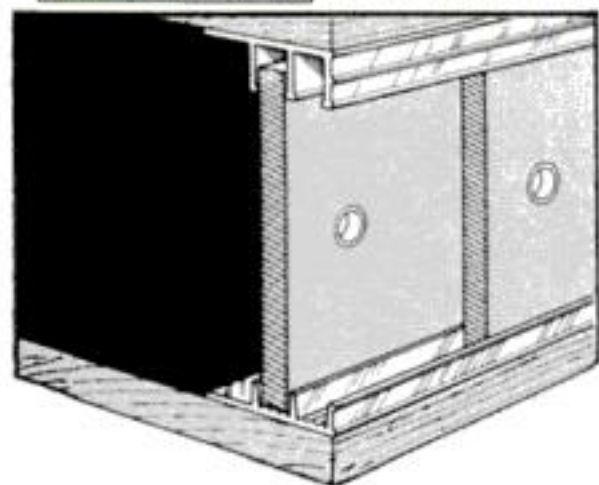
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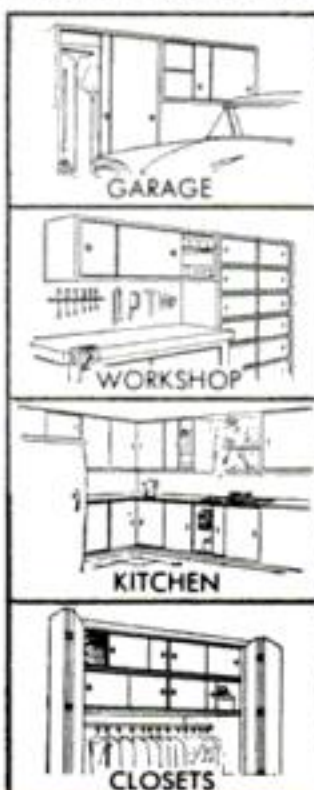


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At Hardware and Lumber Dealers



**MACKLANBURG-DUNCAN CO.**  
 OKLAHOMA CITY, OKLA.

**Tractor Rolls on 24-Foot Wheels**

[Continued from page 98]

For the two engines and their bases are the Buggie's brake shoes. In normal use, 80 pounds of air pressure keeps them suspended two inches above the bottom of the wheel, until applied.

Between the wheels, 12 feet above the ground, stretches a rectangular steel frame 14 feet long and 10 feet wide. The wheels are attached to it in such a way that they pivot with a spindle action. This is to enable the Buggie to amble surefootedly along a hillside, with one wheel higher than the other, at speeds ranging from two to twenty m.p.h.

*The driver steers* the Buggie by advancing one engine and retarding the other. His control lines run along the frame, into the axles, and down to the engines through slots in the bottoms of the axles. The Buggie can turn around in a space no bigger than its own width.

As if the Bunyan Buggie weren't grotesque enough already, it also has two long arms, hydraulically controlled, that hold a six-ton bulldozer blade out in front of it. The blade, 30 feet wide and 6 feet high, can be extended 14 feet ahead of the wheels. But, although it could push 96 yards of earth at a shove, this blade is not mainly for bulldozing but for stabilizing. Its weight is intended to offset the tendency of the engines to climb up the wheels and tip the whole vehicle backward. As an extra precaution, six-foot wheels on casters are suspended from the back ends of the 'dozer arms. If necessary, the arms can be lowered at the rear until these wheels touch ground, to give the Buggie four-point suspension.

How can such a juggernaut even get into the woods, to say nothing of working there? Well, Manning explains, it's not supposed to move among standing trees. The Bunyan Buggie's job is to pick up felled ones and carry them off to nearby loading platforms.

*It can get along without roads*, which, Manning says, account for 40 percent of the cost of logging today. It'll live in the woods, working for months at a time in relatively small areas being progressively cleared of timber. To get there in the first place, it can be dismantled and delivered to a site in five trailer-truck loads. There, it can be reassembled in about three hours, Manning declares, for he says it is

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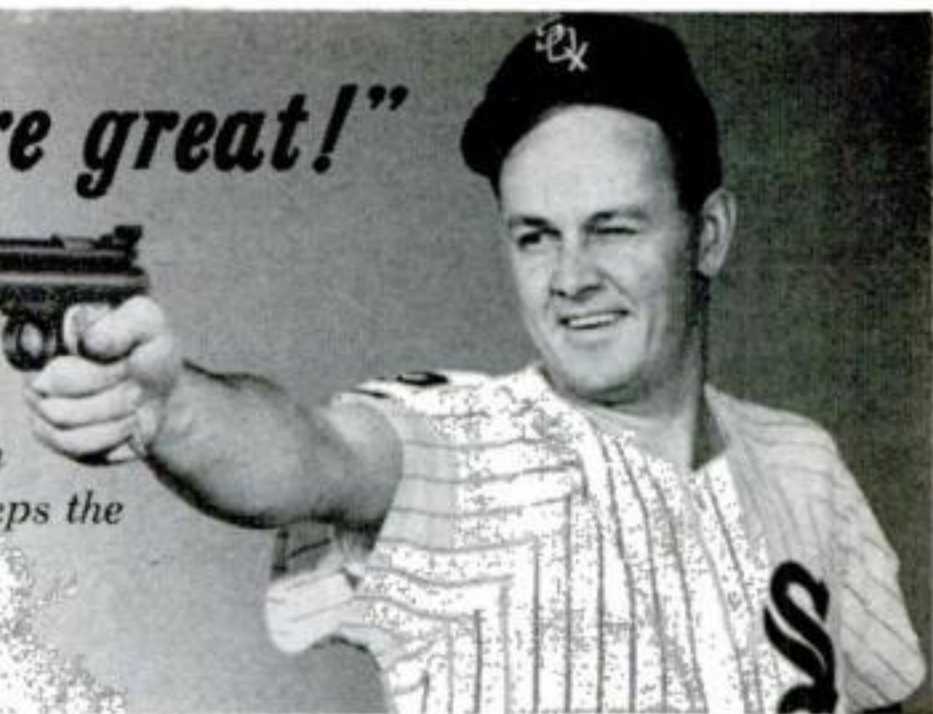


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*Nelson Fox*



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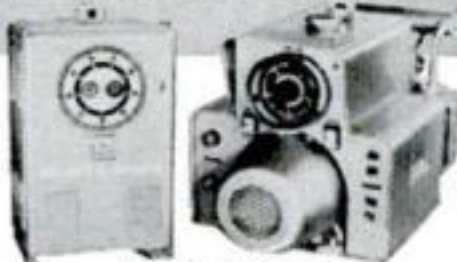
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## **Tractor Rolls on 24-Foot Wheels**

put together with a total of only 72 bolts.

The inventor reports that several logging concerns have expressed serious interest in Bunyan Buggies, which he expects to sell for \$125,000 apiece.

Whatever else may be said about the first one, it is a triumph of improvisation.

Manning obtained a patent on his Buggy several years ago, but only lately has he raised enough money to build one. And because the money had to be stretched as far as possible, he resolved to construct the prototype for one-fourth of what a production model of it will probably cost.

A scale model he built first was powered by nine little electric motors, to

.....

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.....

prove that the "monstrosity," as he calls it, would do what he said it would do.

From there on, he improvised. He didn't use blueprints, because to do so would require parts specially made to exact dimensions, costing a fortune.

"I went around to junk yards, found what I could use, then figured out how I could use it," he says.

Some of his bargains were remarkable. He couldn't think where he'd get spokes for the Buggy's wheels till he came across some used rotary-drill pipe from an oil field. Just the thing. He got it for 55 cents a foot; it cost \$7 a foot new.

He acquired a \$6,600 drum hoist for \$125, hundreds of feet of 1 3/4-inch chain at \$3 a foot that had cost the Navy \$67 a foot. His gyros were once pony wheels on the front of a Southern Pacific locomotive. The six-foot wheels dangling from the back ends of the 'dozer arms once rode under a bomber.

And so it went. Whenever the three experienced welders he hired to help him build the prototype couldn't grasp what he had in mind, he drew crude chalk pictures. Somehow, it always worked.

"Heck," says Manning, "a logger, way out there in the wilds, has to improvise every day of his life. Why, I improvised a chain saw 10 years before it was invented!"





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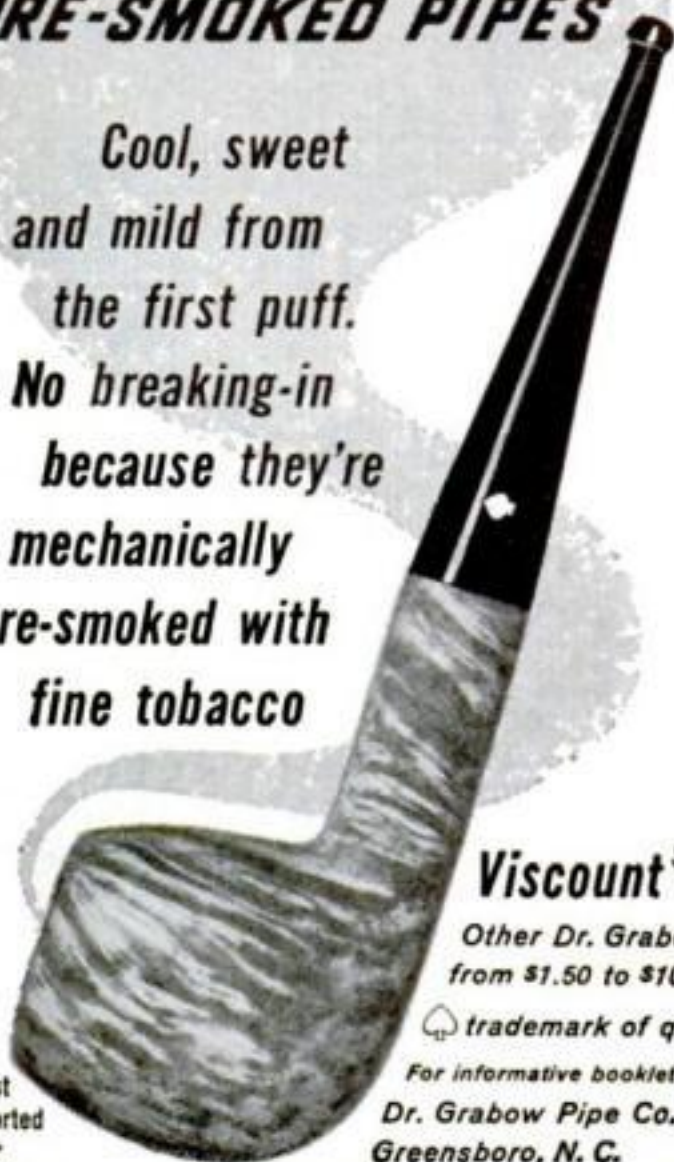
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**CYANAMID**

## Fitting Hydrofoils to My 14-Footer

[Continued from page 136]

use, but lessens rigidity and simplicity.

**How big a motor?** Generally, a motor that will make the boat plane without foils will be powerful enough to fly it. A big motor will shorten the takeoff run, but you'll have to throttle it way back when foil-borne for the same reason that you wouldn't put a jet engine on a Piper Cub—full power would throw it out of control.

I find that an 18-horse motor gives me all the flying speed I want in the 385-

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**That's right. And July PS tells**  
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pound boat shown. Even when the gross weight (including a 200-pound passenger, fuel tank, motor, and gear) has totaled as much as 950 pounds, the oak foils have shown no overload strain or flutter.

Even if your boat is a hefty lapstrake job, the oak foils will certainly lift it, but you might not be able to share the fun with a passenger.

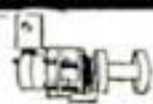
**Taking off.** Flying a runabout is only a bit less exciting than skimming along in the PS Flying Platform—the hull around you gives a comfortable feeling of security that you don't get in the Platform's high, exposed bucket seat. Oh, you'll know you're flying all right, but it's more like flying in an airliner.

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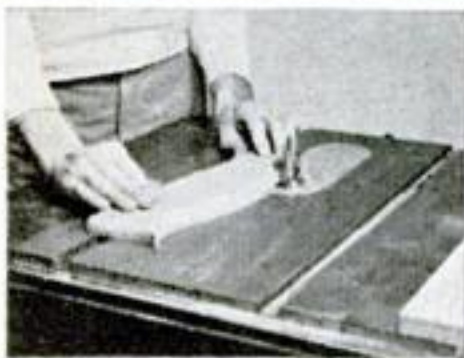
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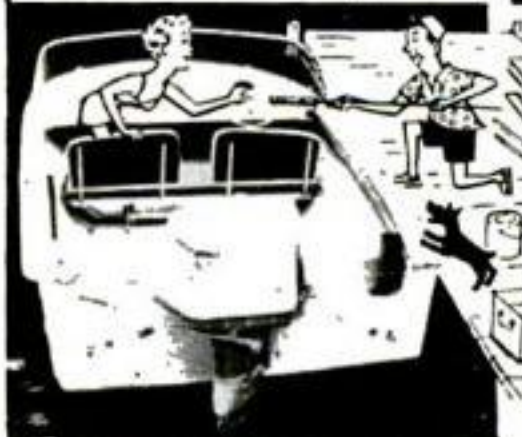


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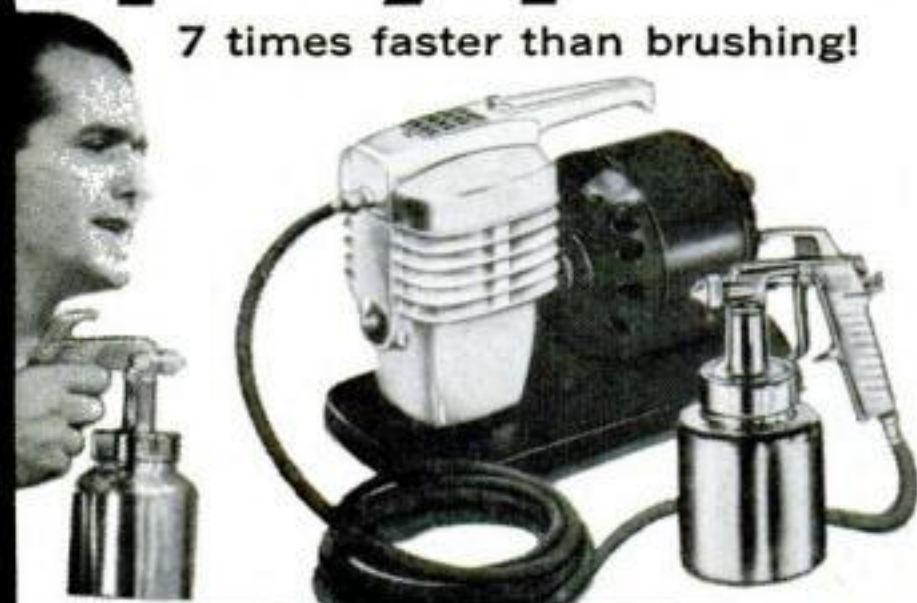
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Prices are without batteries.

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DELTA ELECTRIC COMPANY, 325 W. 33rd St., Marion, Indiana

## The Popular Science Kinderwagen

[Continued from page 117]

part of one inside-toothed mower wheel. Mark out a sector of the wheel with two more teeth than on the pinion. Drill close-spaced holes around the hub, outside the marked sector, to ease sawing. With a spoked wheel, saw through all but one spoke at the hub, then cut the desired sector free at the rim.

Leave a section of rim centered outside the gear teeth, or weld on a lug for the tie rods. Drill  $\frac{5}{16}$ " holes  $\frac{7}{8}$ " apart in this piece, countersinking both sides well to allow the rods some angular action.

The gear sector turns on the same stud or spindle as the mower wheel did. Saw this stud off the mower sideplate, leaving it  $\frac{1}{16}$ " longer than the sector hub. Open out the hole in the stud to take a  $\frac{1}{2}$ "



## How You Can Get Full-Size Plans

Like to build the Kinderwagen from full-size plans? Send \$2 to:

Gilliom Power Tools  
1109 North Second Street  
St. Charles, Mo.

For another \$3 you can also get the handsome, cast-aluminum steering wheel above. It was especially designed for the Kinderwagen.

bolt. Mount the stud on the underside of the dashboard, with a washer between. Slip on the sector and another  $\frac{1}{2}$ " washer, insert the bolt, and pull the nut up against a washer and lock washer above the dashboard.

Saw the hub off a mower pinion. Then weld it to the  $\frac{5}{8}$ " steering shaft (if necessary, bore it out or bush it down).

The shaft turns in a flanged bearing screwed on inside the dashboard. You can buy the bearing or adapt a  $\frac{1}{2}$ "-pipe floor flange by screwing in a  $\frac{1}{2}$ " copper-tube adaptor and drilling this out to  $\frac{5}{8}$ ".

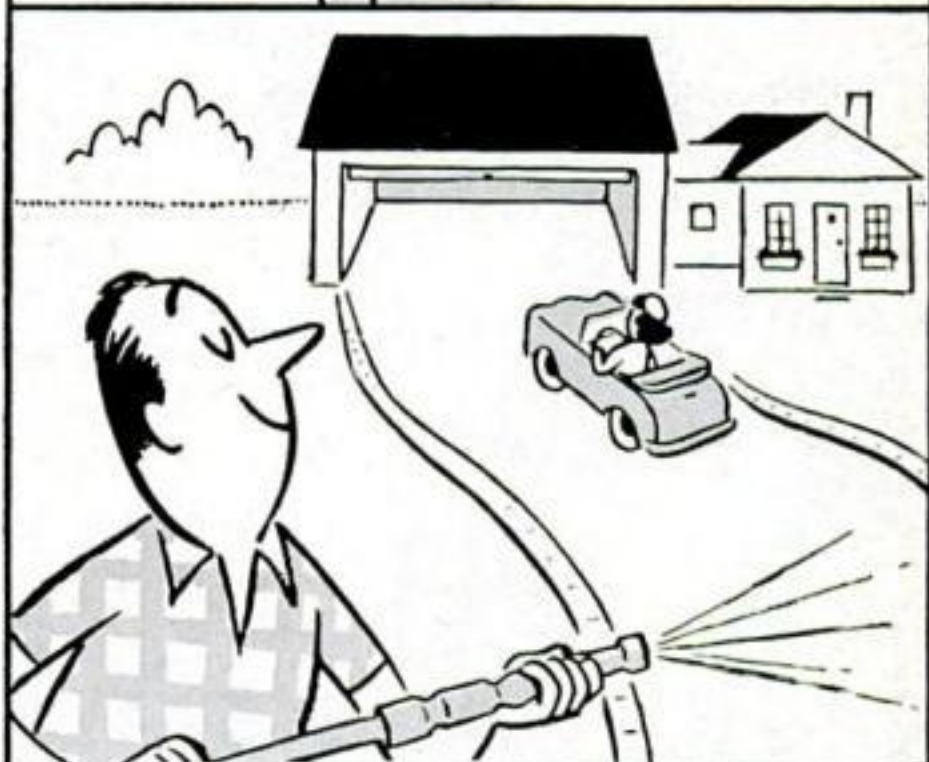


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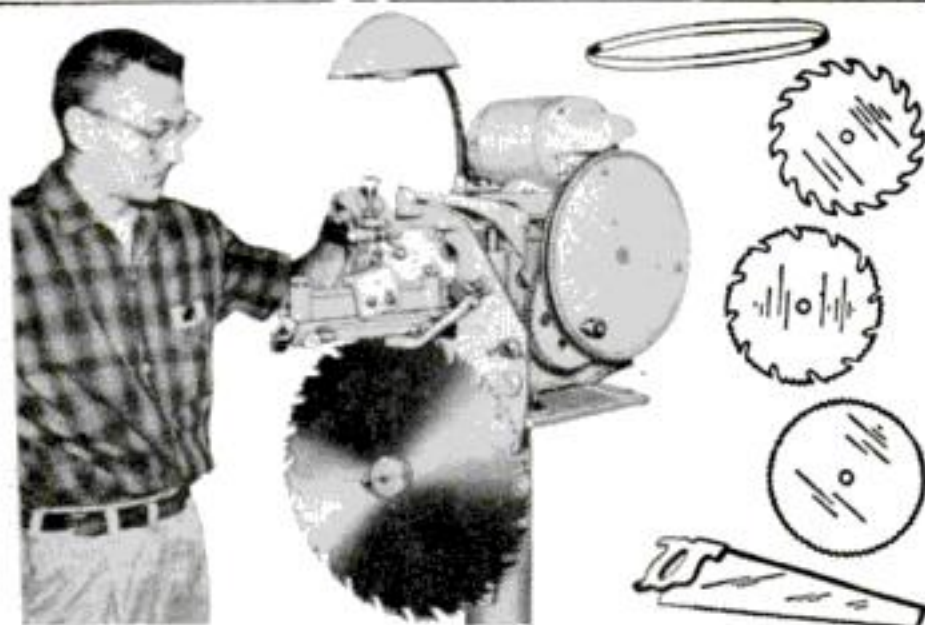
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## The Popular Science Kinderwagen

A steering wheel can be purchased, or built up from  $\frac{1}{4}$ " hard composition board and plywood. Round the rim well, sand smooth, and shellac or varnish it. The hub can be a flanged bearing, or made of pipe fittings. Do not mount the wheel until the front wheels are aligned.

Steering knuckles and wheel spindle are  $\frac{5}{8}$ " shafting heated to redness with a welding torch and bent at 90 degrees. Any welding shop can do this. Drill and slot the knuckles after bending; simply clamp them flat to drill the  $\frac{3}{8}$ " hole for the steering arm at right angles to the wheel spindle.

Steering arms, if made of hot-rolled steel, can be flattened by hammering cold. Countersink the  $\frac{5}{16}$ " holes in them from both sides.

Tie rods are bent from  $\frac{5}{16}$ " steel rod. Right-angle bends 1" long are easily made by clamping the stock in a vise and

## LIST OF MATERIALS

### WOOD

$\frac{1}{2}$ " fir plywood, 4' by 4' (floorboard, seat, seat back, tail fins, front axle)  
 $\frac{3}{4}$ " fir plywood, 2 $\frac{1}{2}$ ' by 4' (frame panel, engine deck, dashboard, seat supports, front axle)  
 $\frac{1}{4}$ " plywood and  $\frac{1}{4}$ " hard composition board, each 10" by 10" (steering wheel)  
two-by-six (1 $\frac{5}{8}$ " by 5 $\frac{5}{8}$ ") by 4' construction-grade fir (beam and spacer blocks)

### METAL

$\frac{5}{8}$ "-dia. c.r. steel 68" long (steering shaft, knuckles, rear axle)  
 $5/16$ "-dia. c.r. steel 19" long (tie rods)  
 $\frac{3}{8}$ "-dia. hot-rolled steel 9" long (steering arms)  
 $\frac{1}{4}$ "-by-1"-by-18" flat steel bar (front axle support, knuckle bearings, yoke lug)  
 $\frac{3}{8}$ "-dia. c.r. steel 33" long (control rod and pin)  
 $\frac{1}{8}$ "-by- $\frac{3}{4}$ " flat steel bar 36" long (radius rods, dashboard brackets, control-rod U bracket)  
1 $\frac{1}{8}$ "-by-1 $\frac{1}{8}$ "-by-29" angle iron (jackshaft and spring brackets)  
 $\frac{3}{4}$ "-dia. c.r. steel 30" long (jackshaft)  
 $\frac{1}{2}$ "-by-2"-by-5" aluminum bar (control lever)  
 $\frac{7}{8}$ "-o.d. aluminum or steel tubing (control handle)  
 $\frac{1}{2}$ "-dia. c.r. steel 4 $\frac{1}{2}$ " long (clutch-lever shaft)  
 $\frac{1}{4}$ " pipe 38" long,  $\frac{1}{4}$ " elbows (2),  $\frac{1}{4}$ " lock nuts (4) (jackshaft yoke, wheel spacers)  
 $\frac{1}{2}$ " pipe 6" long (knuckle bearings)

### MISCELLANEOUS

8" A-section V pulley,  $\frac{3}{4}$ " bore (1)  
8" pressed-steel V pulleys, hubless, 1 $\frac{1}{4}$ " center holes (2) [Salem Stamping & Mfg. Co., 631 W. State St., Salem, Ohio]  
2 $\frac{1}{2}$ " pressed-steel or cast-iron V pulleys,  $\frac{3}{4}$ " bore (2)  
2 $\frac{1}{2}$ " or 2 $\frac{3}{4}$ " V pulley to fit engine shaft  
33" A-section belt  
31" A-section belts (2)  
2"-by-2" flat pulleys,  $\frac{3}{4}$ " bore, die-cast (2) [Central Die Casting & Mfg. Co., 2935 W. 47 St., Chicago 32]  
rigid pillow blocks,  $\frac{1}{2}$ " bore (2)  
self-aligning bronze or ball-bearing blocks,  $\frac{3}{4}$ " bore (2) [Congress Drive Div., 3750 E. Outer Dr., Detroit 34]  
 $\frac{5}{8}$ "-bore-by-3 $\frac{3}{4}$ "-dia. die-cast flanged hubs (2) [Chicago Die Casting Mfg. Co., 2510 W. Monroe St., Chicago 12]  
13-gauge,  $\frac{1}{2}$ "-i.d.-by-3 $\frac{3}{4}$ "-long compression springs (No. 8C 13 in standard assortments)  
 $\frac{3}{4}$ "-bore steel shaft collars (2)  $\frac{5}{8}$ "-bore steel shaft collars (11)  
5/16"-by-3" U bolts (2)  
1 $\frac{3}{8}$ "-by-1 $\frac{3}{8}$ " stamped corner brackets (10)  
steel or aluminum turnbuckle, 5/16" thread  
throttle control cable  
10"-by-2.75" lug-type, semipneumatic wheels, with  $\frac{5}{8}$ "-bore ball bearings (4)  
four-cycle horizontal-shaft gasoline engine, 1 $\frac{1}{2}$  to 2 $\frac{1}{2}$  hp.



### **The Popular Science Kinderwagen**

slipping on a piece of  $\frac{1}{4}$ " pipe as a lever. Note that the ends of the left-hand rod lie at an angle of 75 degrees to each other.

Discard the right-hand-threaded eye of a turnbuckle, and thread a tie rod  $\frac{5}{16}$ "-18 to fit the turnbuckle in its place. Open the eye that has left-hand threads, reshaping it to a 90-degree leg.

Drill holes for cotter pins at each bent end. Assemble with  $\frac{5}{16}$ " S.A.E. washers under the pins.

*Wheels for the Kinderwagen* should be 2.75-by-10" semipneumatics, with ball

bearings for a  $\frac{5}{8}$ " shaft (about \$6 each). A similar mail-order wheel (about \$3.50) is also okay, but lighter 1.75-by-10" wheels won't work the reverse.

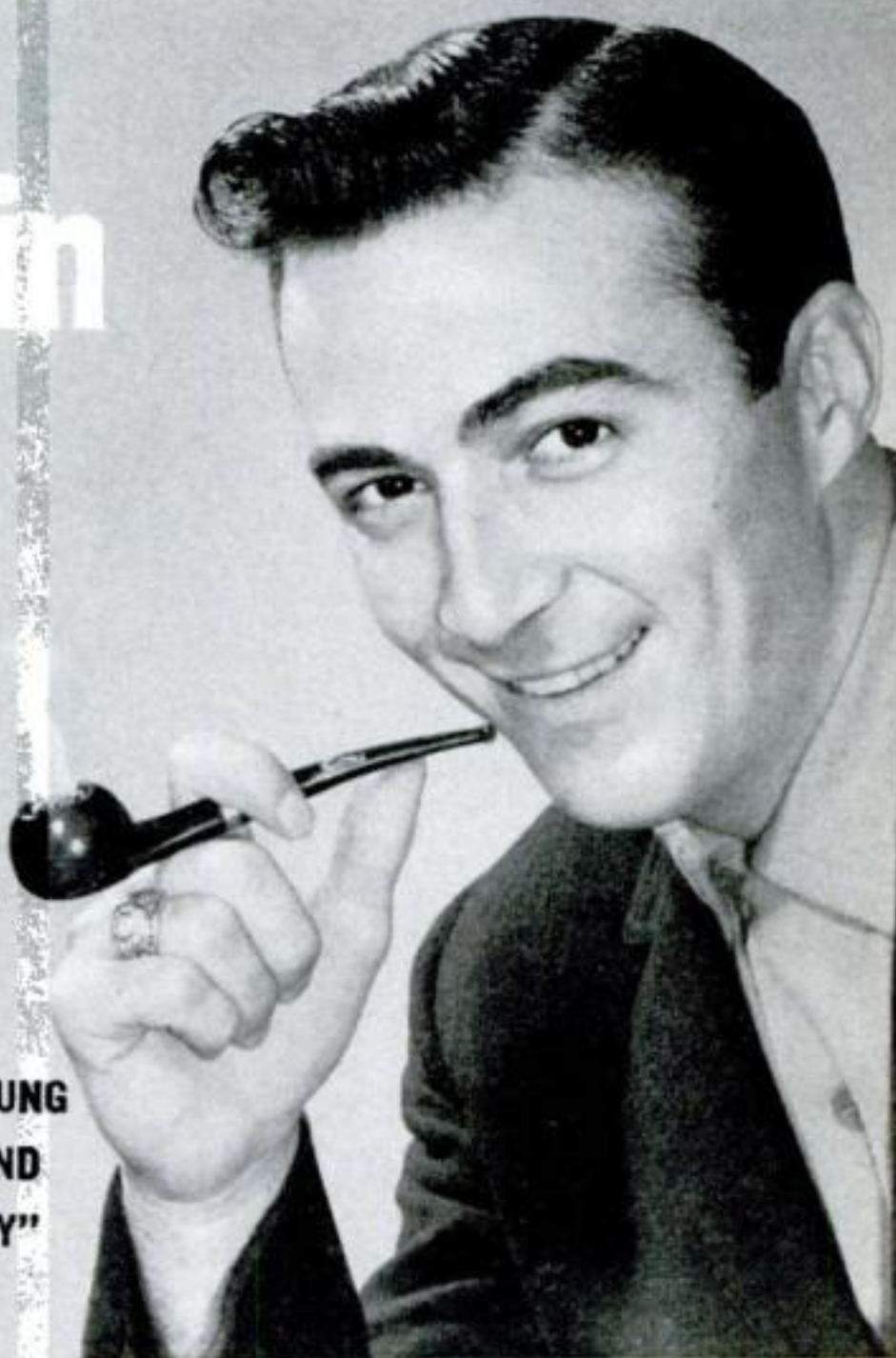
Install front wheels with shaft collars on both sides, first filing flats on the spindle for the collar setscrews. Adjust the tie-rod turnbuckle to align wheels parallel. Set the steering wheel on its shaft, spokes aligned in the straight-ahead position. Then drill through the hub for a  $\frac{3}{16}$ " bolt or, if the hub fastens with a setscrew, file a flat on the shaft.

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## Hailstorms

[Continued from page 91]

than 15 minutes in any locality, they can spill a prodigious amount of ice pebbles on the ground. A severe Kansas storm in 1951 piled the hailstones a foot deep on the level. In Iowa, in 1897, fierce winds drove hail into six-foot drifts.

Col. E. J. Fawbush and Maj. R. C. Miller, Air Force officers who founded the Severe Weather Warning Center, now at Kansas City, Kan., have estimated that a hailstone will survive a free fall of 9,000 feet without shrinking in size. They also found that nearly all the biggest hail is produced when the freezing level is from 7,000 to 9,000 feet.

Radiosonde samplings of the upper air at dozens of places throughout the U. S. every 12 hours keep weather forecasters in touch with atmospheric conditions that are likely to produce hailstorms. But after they have broadcast their warnings of the danger points, there's little that people there can do but wait and pray.

**Arrows and incantations.** Men dreading the injury and frequently the total disaster that hail brings to growing crops have tried for centuries to prevent it from forming. They used to shoot arrows and hurl javelins at storm clouds. They sought out "weather wizards" and paid for expensive incantations.

At least, they recognized that hail is born in thunderclouds. Eventually, people came to believe that electricity was its creator. If they could somehow drain the electricity out of the clouds, they were sure they'd have the hail licked.

So, early in the nineteenth century, European farmers began setting out a million tall, metal-tipped poles among their crops and grapevines. This hopeful effort ended depressingly in 1827, after hail knocked down many of the poles.

Meanwhile, attempts to put an end to hail came closer to the heart of the matter. Convinced that it would be more effective to break up thunderclouds than to draw their lightning, a few men tried doing it with explosives.

**And smoke rings.** In France, bomb-carrying rockets soared up to burst in the darkest regions of approaching thunderstorms. In Austria and northern Italy, in the 1890s, some people remembered that their ancestors had fired cannon at clouds, from time to time, to prevent hail.



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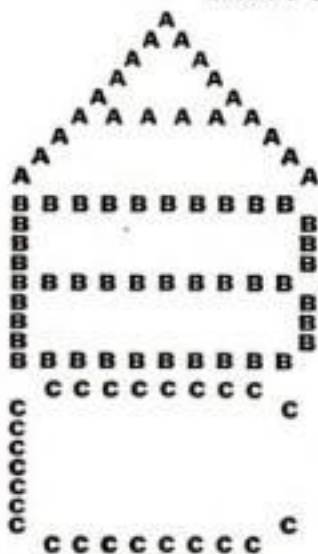
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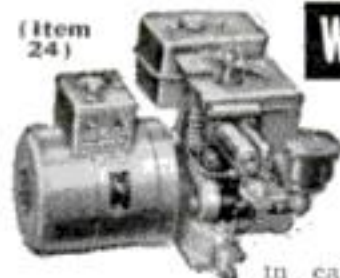


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## Hailstorms

This scheme was brought to life again. Anti-hail cannons, with flaring sheet-iron mouths pointed skyward, wheeled into action across Europe. Loaded with gunpowder or acetylene, they blew big smoke rings into the thunderstorms.

Some Belgian aeronauts in 1908 won brief interest by sending small, dynamite-laden balloons up into thunderclouds and exploding them. The results were more picturesque than positive.

By 1912, statisticians were estimating that hail was doing \$200,000,000 worth of damage around the earth each year. That season, there was a gala revival of the ancient anti-lightning measures.

Frenchmen led the movement. Their goal was to erect lines of enormous lightning rods of pure copper across the favored paths of summer storms and pull "electric Niagaras" out of the heavens. Quite fittingly, the kingpin of the first line of defense against hail was to be the Eiffel Tower. Decorating this world-famous landmark from its tip to one of its toes with a cheery stripe of bright copper was an inspired way to launch the scheme. But there it ended. What the copper attracted was not lightning but thieves, who made off with it.

"**Electric net.**" The last flicker of the idea was seen on a mountain top in the Ardèche region of France in 1917. Using unalluring iron in place of copper, a nest of metal-tipped posts linked by barbed wire was erected on the summit of an extinct volcano, 1,500 feet above sea level. It was called "an electric sweep net." The region is known for violent hailstorms. After the sweep net was in place, farmers reported that for two miles to leeward of it, hail was reduced to "inoffensive sleet." It was not long, though, before they found the sweep net to be as disillusioning as an anti-hail cannon.

Since then, cloud seeding with dry ice and silver iodide has been claimed to be a dependable way to prevent the formation of hail. The U. S. Weather Bureau, at last report, remains unconvinced.

Hail insurance came into existence in 1880. U. S. farmers alone now blanket their growing crops each year with more than \$700,000,000 worth of it. In a recent 20-year period, they paid \$550,000,000 for the protection, collected \$300,000,000 for the damage hail did to them.



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## The World's First Sports Car

[Continued from page 127]

given way to modern 20" bicycle tires.

**Who owns them?** As might be expected, the A. O. Smith Corporation has one of the restorations in its museum. Briggs & Stratton, oddly enough, has none; but there is one that's owned personally by one of its executives, F. P. Stratton.

James Melton, the well-known singer and antique-car buff had one on exhibit at his Florida "Autorama," but sold it recently to a collector in Reno, Nev. (Melton has since built a replica, but this isn't included in my count since it wasn't restored from original parts.)

Another Flyer that changed hands recently was salvaged from a neighbor's

.....

**Next Month: A wheelbarrow without wheels? Right. The Flying Cart floats loads up to 200 pounds on a cushion of air. Power: a chain-saw engine. Build one? Sure. See July PS.**

.....

junk heap by the late John Baum of Ephrata, Pa. Baum rebuilt the wreck, entered it in many meets, and walked—or rode—off with a trunkful of prizes. The car is still taking prizes for its present owner, Kenneth Neal of Jacksonburg, Ohio.

New Jersey takes top honors for the largest concentration of restored flyers—three. They are owned by Robert Baier, a Milltown engineer; A. Stanley Fisher, a Bergenfield dentist; and Howard Stokes, an Allenhurst attorney. Baier's model, a 1917 Smith, is the earliest of the lot and, quite probably, the oldest authentic restoration anywhere.

The list is surprisingly slim for a car that was in continuous production for four or five years. Existing records are vague on just how many were made, but the number must have been substantial.

**Are they worth hunting for?** Not for everyone, certainly. But a Flyer can be a rare prize for a sharp-eyed collector who combines a love of motor history with the skill needed to turn a heap of old parts into a polished antique. As a car, the strange-looking, low-powered buckboard had as many faults as virtues. But as a collector's item it ranks among the most delightful and unusual treasures out of America's past.



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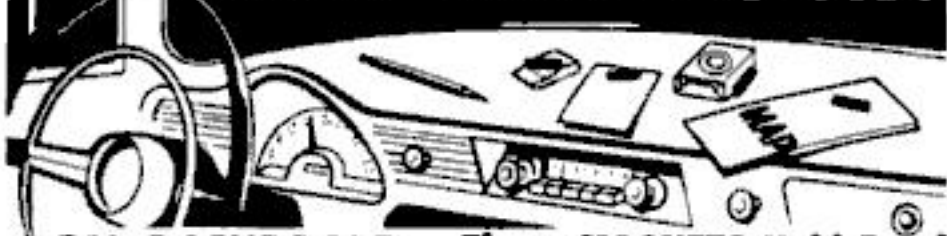
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**DOUBLE-LENGTH  
FEATURE OF  
TRUE SCIENCE  
ADVENTURE**

**The Ship  
That  
Came Back  
from the  
Grave**

*By a daring feat of seamanship, the mysteriously sunken  
Cape Douglas was raised from a record 666-foot depth  
to become a silent witness at a strange criminal trial*

**By Wesley S. Griswold**





## I. The Sinking

*On the morning after the sinking, Odd John Solnordal, skipper of the ill-fated Cape Douglas, told reporters his fishing boat had struck a submerged object.*

ON A December night of sudden squalls and unpredictable glimpses of stars, this remarkable true story of the sea began.

The scene was an arm of Puget Sound—the East Passage between Seattle and Tacoma. The year was 1958. The vessel was the Cape Douglas, a diesel-powered 78-footer. She was headed for the bottom, and for a major role in a drama that would combine high technical skill, cool feats of daring, and courtroom conflict over a rare crime.

Skipper and chief owner of the Cape Douglas was a toil-aged young man of 28, a blue-eyed, sandy-haired son of gener-

ations of Norwegian seafaring men. His name was Odd John Solnordal: Odd, in honor of the Norse god Odin; John, to please his mother. He had a quick, boyish grin for the fleeting fun of life, but normally his pale, sad face was set in a mask of wistful disappointment. One shoulder of his lean body was hunched for all time against heavy burdens assumed too young. He had gone to sea at 14.

At this moment, three nights after Christmas, he was leaning over the boat's wheel, peering morosely into the dark.

The only other man aboard the Cape Douglas that evening was the engineer, Kenneth Ness, a burly fellow twice Solnordal's size. No more were needed, for the boat was on a housekeeping errand. She was bound for a shipyard to have a new winch installed.

It was nearly time for Ness to take his turn at the wheel, and he sleepily emerged from the cabin. With a brief word about getting something to eat, Solnordal left the engineer in charge and went below.

A little while later, he was back.

"Go get yourself some grub, Kenny," he said. Ness was willing enough. He relinquished the wheel and headed for the little galley.

## II. Salvage Operations .....

THE unique recovery effort began early in January, 1959. It started with an almost casual flight by a small float plane. The pilot worked for the U. S. Salvage Association. It was the duty of that organization, acting for insurance underwriters, to locate the sunken Cape Douglas and find out if it could be raised. Solnordal had insured the boat for \$80,000 a few weeks before it was sunk, and had since put in a claim for the full amount.

The plane pilot, that morning, had intended just to practice landings. His boss, however, asked him if he'd fly around near where the Cape Douglas had sunk and see if he could spot an oil slick on the water.

He found one, all right. Curiously, it appeared to be quite a way from where it was expected. Two or three days later, the pilot flew back. This time, he landed beside the oil slick, and saw that it was bubbling up from below. He fixed its position—nearly five miles south of where Odd John had said his craft had sunk.

Not long afterward, the jaunty little Neper, a boat belong-



*Jaunty little Neper and its electronic Sea Scanar located the sunken wreck.*



Suddenly, the big engineer reappeared. "Hey!" he shouted. "What's wrong with the boat?"

She seemed to be staggering. Ness lurched off below deck to check the steering machinery. He returned in a dash.

"The engine room's half full of water," he yelled. "We're sinking!"

**I**T WAS obvious that he was right. The Cape Douglas stumbled and began to bury her nose in the water. The two men scrambled away in her rubber life raft. Some 50 yards off, they stopped paddling for a few awed moments to watch the big fishing vessel slide out of sight. When she sank, they were sure no man would ever see her again. The water there, a little more than a mile offshore, was many hundreds of feet deep.

They headed for Three Tree Point, on the mainland. Around midnight, soaked by another squall, they pounded on the door of a home on the Point. The owner took them in and lent them dry clothes.

The next morning, Solnordal told reporters and a Coast Guard officer that the Cape Douglas had struck a submerged object. It had been "something that felt very heavy, like metal," he explained. After colliding with it, the boat sank rapidly, he said.

A woman who read the newspaper ac-



*Cross marks the spot in Puget Sound's East Passage where the Cape Douglas went down, and was later salvaged.*

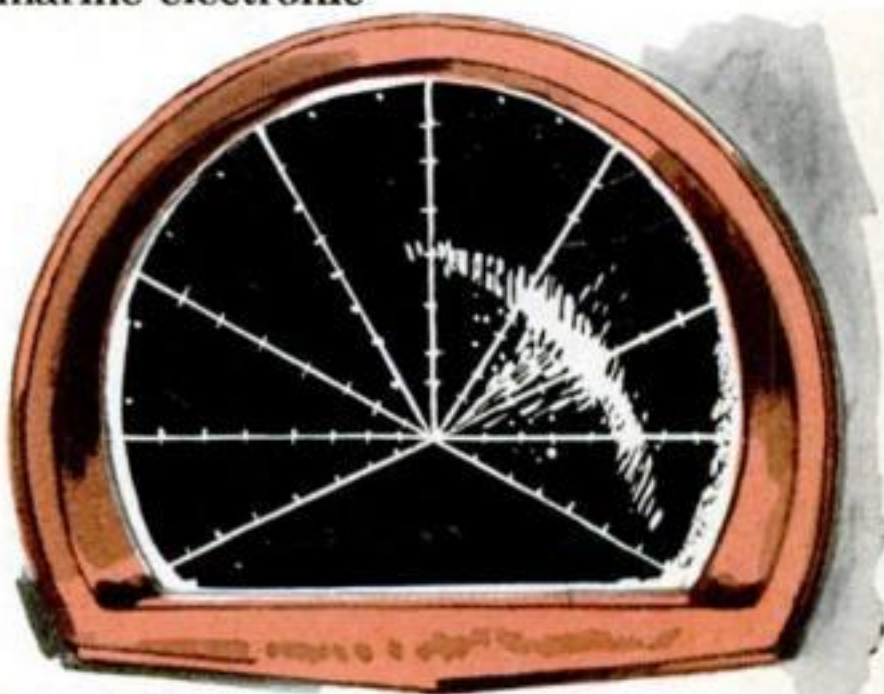
counts telephoned later to say she thought she knew what the Cape Douglas had hit: a torn and jagged metal float that had been moored to the beach outside her cottage on the Sound, but had disappeared in a recent storm.

In the weeks and months that followed, Solnordal retold his story of the sinking to insurance investigators and the FBI. Then an extraordinary feat of salvage led to a dramatic revelation of what had really happened to the Cape Douglas.

.....

ing to Minneapolis-Honeywell's Seattle Development Laboratory, nosed up to the oily stain on the surface of the East Passage. The Neper is used to test special marine electronic devices. She is not normally for hire. But the U. S. Salvage Association had successfully negotiated for her help.

**A**BOARD the Neper was an ingenious apparatus called a Sea Scanar. It's a kind of underwater radar. Playing a narrow beam of high-frequency sound through the depths like a searchlight, the Sea Scanar catches echoes from objects that intercept the beam. The echoes are amplified, and can be both seen and heard. They appear on a scope as tiny blips of greenish-white light, which paint a brief outline of whatever reflects the pulses. At the same time, over a speaker, come curious but distinctive noises, which help to identify the object. Mud, for instance, returns a rough scratching sound. Metal or rock produces a sonar thump that is like a rap on a muffled drumhead.

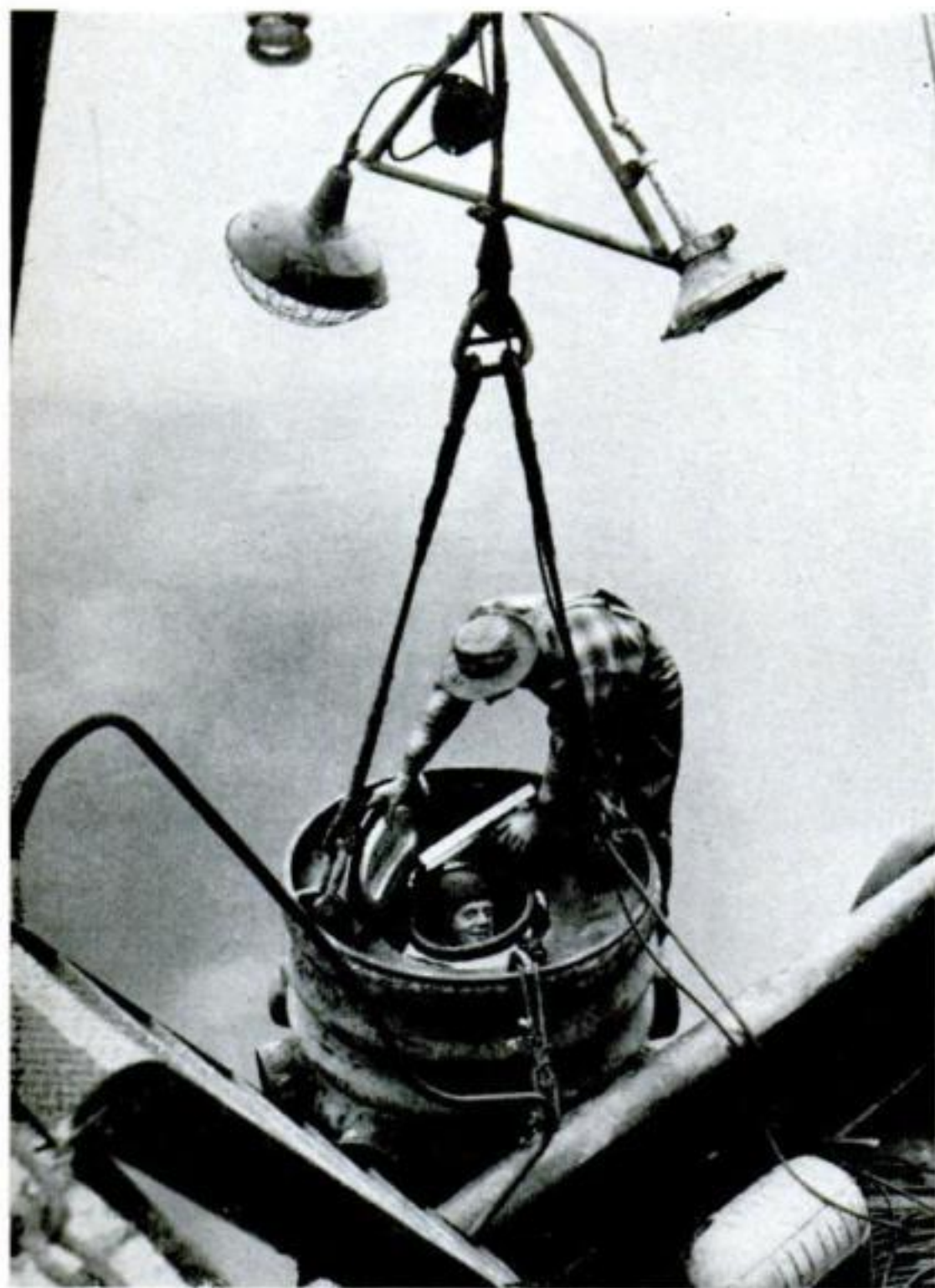


*What the scope of Neper's underwater "radar" picked up—a boat-shaped object.*



## DOUBLE-LENGTH FEATURE OF TRUE SCIENCE ADVENTURE

With the Sea Scanar's magical help, the Neper found a boat-shaped object below the cloud of surface oil, though far, far below. Scanned from the side, there was the unmistakable silhouette of a fishing vessel of the Cape Douglas' class, with superstructure far forward.



*Smiling, Leiter Hockett is about to have the hatch clamped down on him before perilous descent in homemade diving chamber. On first try, he found nothing. Following day, with Sea Scanar help, flood lamps attached above his chamber spotlighted Cape Douglas wreck.*

Dismayingly, it was 666 feet down. No man in a diving suit could be lowered more than half that depth without risk of being crushed to death by the enormous pressure of the water. Yet unless a diver could reach this object, it could not be positively identified.

Supposing it was the Cape Douglas, was it too badly damaged to be worth salvaging? Only a diver who could look closely at the hull could answer that.

And even if the damage were not severe, how could the vessel possibly be raised? No one in the large community of sea-wise men around Seattle had ever heard of a successful salvage job from anything like that crushing depth.

THE Neper, meanwhile, had anchored a buoy to the deep-drowned hull and gone home. Officials of the U. S. Salvage Association regarded the buoy and its connected problems in perplexity.

It was then that a seasoned Seattle diver and salvager named Leiter Hockett stepped

forward. He offered a weird solution to the initial puzzle of how to identify and inspect the boat that lay so far out of reach. He offered to be let down at the site in a homemade diving chamber, which he had built eight years before.

Some people said this object looked more like an eccentric oil drum than anything else. Actually, its corrugated steel shell, nine feet long and around 30 inches across, had been the firebox flue inside a Scotch marine boiler. It had been made to withstand external pressure of as much as 450 p.s.i. Hockett figured that this was roughly equivalent to the pressure of water at a depth of 1,000 feet. He had decided to convert the boiler flue into a diving chamber.

The result was strange-looking and obviously dangerous, but it had worked so far.

Hockett had stood the cylinder on end and cut a belt of nine small, round holes at eye level in the folds of its steel skin. He had filled the holes with laminated, shock-resistant



glass, 4½ inches in diameter and 1⅝ inches thick. The windows were tilted slightly downward, so he could see below when he was in the chamber.

The cylinder had an inside diameter of only 27 inches. Hockett got in and out through an oval hatch, so small that it seemed impossible for his square body and massive shoulders to squeeze through. As it was, when he was ready to make a descent in the diving chamber, he had to toss his fleece-lined jacket and trousers through the hatch, wriggle after them in his underwear, and put them on inside.

To weight the chamber properly, he had filled the bottom end with a half-ton of cement and steel, and covered the foot-high heap of ballast with a floor plate.

ONCE the hatch cover was closed above him, like the door of a tomb, it was bolted and barred from outside. His only connections with the surface while under water were a two-way telephone and the supporting wire cable. They were paid out by a 90-hp. engine on a floating crane that lowered and raised his chamber as if it were a plumb bob.

When the hatch clanged shut, Hockett donned an Air Force breathing mask and began to inhale pure oxygen from a tank in the chamber. Soda-lime containers absorbed the carbon dioxide he exhaled. The chief hazard was the slow rise in atmospheric pressure. Within the tiny sealed chamber, it went up at the rate of three pounds an hour. The safe limit was a rise of 15 pounds, so he could not stay below more than five hours.

It was this outfit, together with his services, that Hockett now invited the U. S. Salvage Association to hire for probing the dark waters beneath its marker buoy in the East Passage.

With large doubts about his safety, but at a loss for an alternative method, the Association gave him a try.

On a February day, Hockett made his first descent. It was an eerie journey through a world that steadily darkened and chilled as he sank through it. It would have been wholly silent, too, had the telephone line not been cackling with the banter of the carefree men on the crane.

Two 1,000-watt flood lamps attached to a bracket on the wire rope 15 feet above the diving chamber spread a diffused light through the crowding gloom as he dropped down deeper and deeper by the buoy's anchor line. The water was full of sediment, and a storm of small black particles whirled about the windows of his chamber. He was down for a full five hours, and could find nothing.

The next day the Neper was persuaded to return. Its Sea Scanar guided Hockett's second descent so exactly that, at the end of 10 minutes' slow fall, he found himself dangling within a foot of the sunken boat's mast.

For four hours, he was maneuvered around the hull like a leaden puppet, searching for identifying details and checking on the boat's condition.

All this time, the weight of water on just the small top of his diving chamber was 250 tons, he estimated afterward. Even 300 feet above him, an empty oxygen tank that was one of the floats attached to the wire rope to make it lighter to handle had already been crushed flat by the pressure.

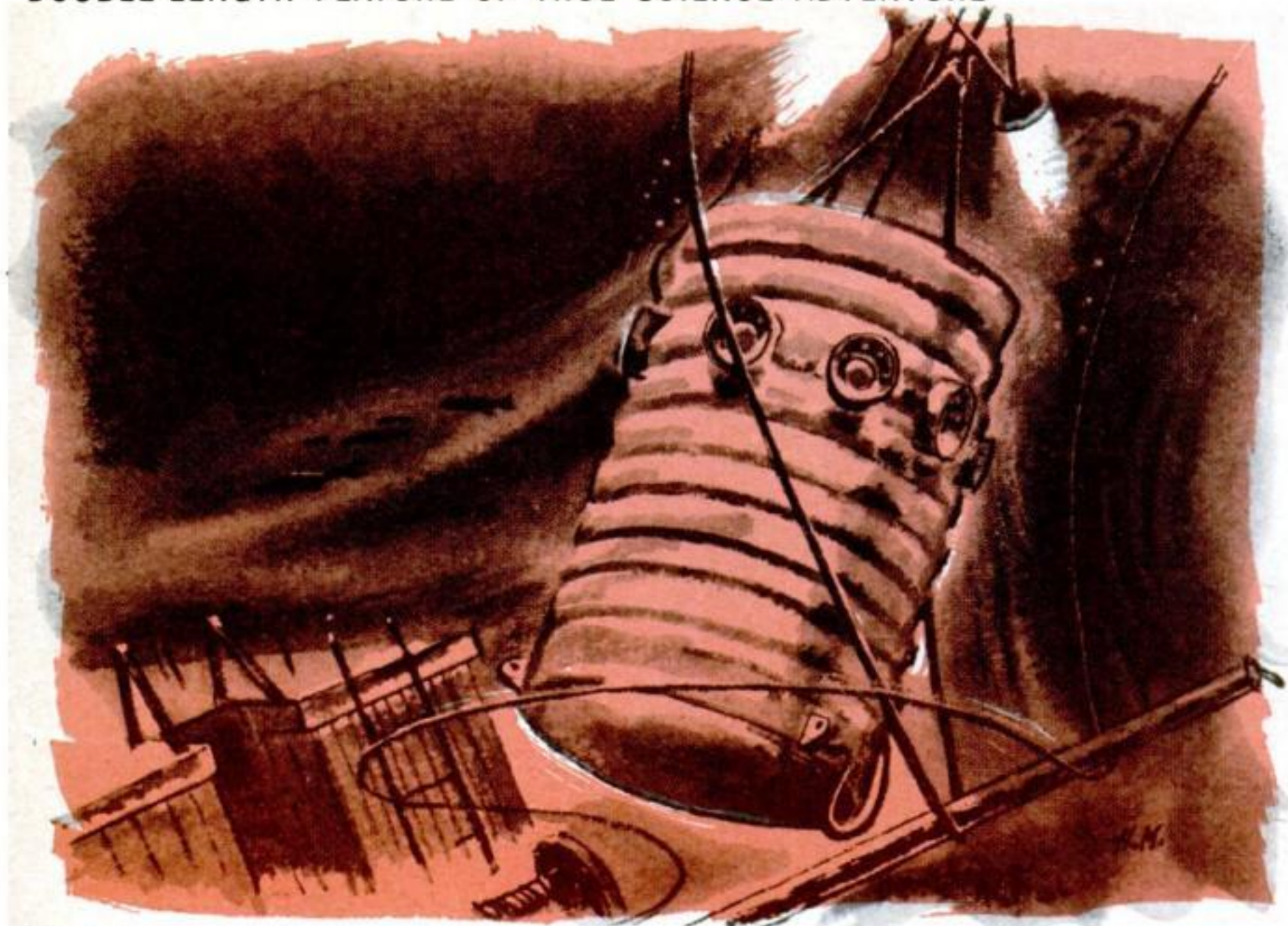
But Hockett, swinging gently at the bottom of the long



*For four hours, Hockett was maneuvered around the hull like a leaden puppet, searching for identifying details and checking on the boat's condition, reporting by phone.*



## DOUBLE-LENGTH FEATURE OF TRUE SCIENCE ADVENTURE



*Anxious moments came when the floating crane began to haul up Hockett and his many-eyed diving chamber. It was entangled in the sunken boat's rigging. Slacking the line and reeling in again didn't help. Breaking him loose by brute force seemed the only chance. But if the rope broke, it meant certain, slow death by suffocation. Then, at a mighty pull, the rigging gave. Hockett was on his way up.*

rope, worked imperturbably in his steel capsule. With hands in pockets to keep them warm, he peered through his windows into the dimly lighted murk. He could see point after point that indicated the hulk before his eyes was actually the Cape Douglas. He could find no sign of damage to her hull, which rested heavily in very soft mud.

**T**HROUGHOUT the slow, cautious inspection, his entire conversation with the man on the floating crane was recorded there on magnetic tape, for possible use in court.

At last, the job was done. Hockett asked to be hauled up.

Then came some heart-stopping moments. The diving chamber tangled in the boat's rigging, like a fishhook snagged on a submerged limb. Several times the crane slacked the line and reeled in again, but it didn't help. Finally Hockett urged the crew on the crane to bust him loose by tugging harder.

There was the terrifying chance that the diving chamber would be torn from its rope. This would plunge Hockett into oblivion in billowy mud. Lost beneath its obscuring cloak, he would slowly suffocate in darkness and silence.

But, under a three- or four-ton pull, the old boiler flue suddenly lurched upward, shedding fragments of rigging as it soared. The crane platform wallowed at the abrupt release of strain, and Hockett bobbed wildly for a few dizzy instants in the distant depths before the ascent could become calm and steady once more.

As Hockett's chamber neared the surface, he opened a valve to bubble off excess pressure before his hatch was op-



ened, and congratulated himself on a historic achievement. He was given an enthusiastic welcome by the relieved men aboard the crane.

The position of the Cape Douglas was then carefully recorded, so that the marker buoy could be removed from the path of other vessels.

But the major task—perhaps impossible—of recovering the sunken boat from its deep grave still lay ahead.

With more reason now than before to suspect Solnordal's story of the sinking, the insurance companies had not yet paid his claim. But should they spend a great deal more money than they already had to find out for certain whether or not the man was lying?

**T**HE question was debated over a period of six months. A compelling point brought up during the arguments was that if, by chance, the boat had been sunk deliberately, proof of that crime might be such a powerful deterrent to potential scuttlers that it would be well worth the cost.

In June, 1959, the underwriters decided to go ahead with the salvage effort. The winning bidder for the baffling job was the Fred Devine Diving Co., of Portland, Ore. Devine, with 47 years of experience and an international reputation in his field, asked for \$35,000 if he were able to raise the Cape Douglas, and not a cent if he failed.

On June 29th, Devine's work vessel, the 200-foot black-hulled *Salvage Chief*, a converted LSM with unexpectedly rakish lines, arrived off Three Tree Point. The *Neper* had reached the spot two hours before, to relocate the Cape Douglas. She had a new marker buoy already in place. Her crew were also able to tell Capt. Devine which way the sunken boat was headed.

Spared the need of groping, the *Salvage Chief* and a helping tug, the *Amak*, promptly paid out 1,500 feet of 1 $\frac{1}{8}$ -inch steel cable between them and, moving side by side, dragged it confidently toward the buoy. They expected to catch the stern of the Cape Douglas with the cable and loosen it from the clutch of the ooze around it.

Instead, bad luck foiled them. The cable sawed the buoy's line and cut the anchor off it. The buoy began to float away, and had to be hauled in.

Capt. Devine then decided, as a long-shot gamble, to lower a grappling hook and try to lift the Cape Douglas by her rigging. But first he had to find her again.

The little *Neper* now moved in and was lashed to the side of the big salvage ship in order to guide the hook with her sonar apparatus. A stainless-steel target, shaped like an hourglass, was fastened above the hook so that the *Sea Scanar* could follow it down to the Cape Douglas.

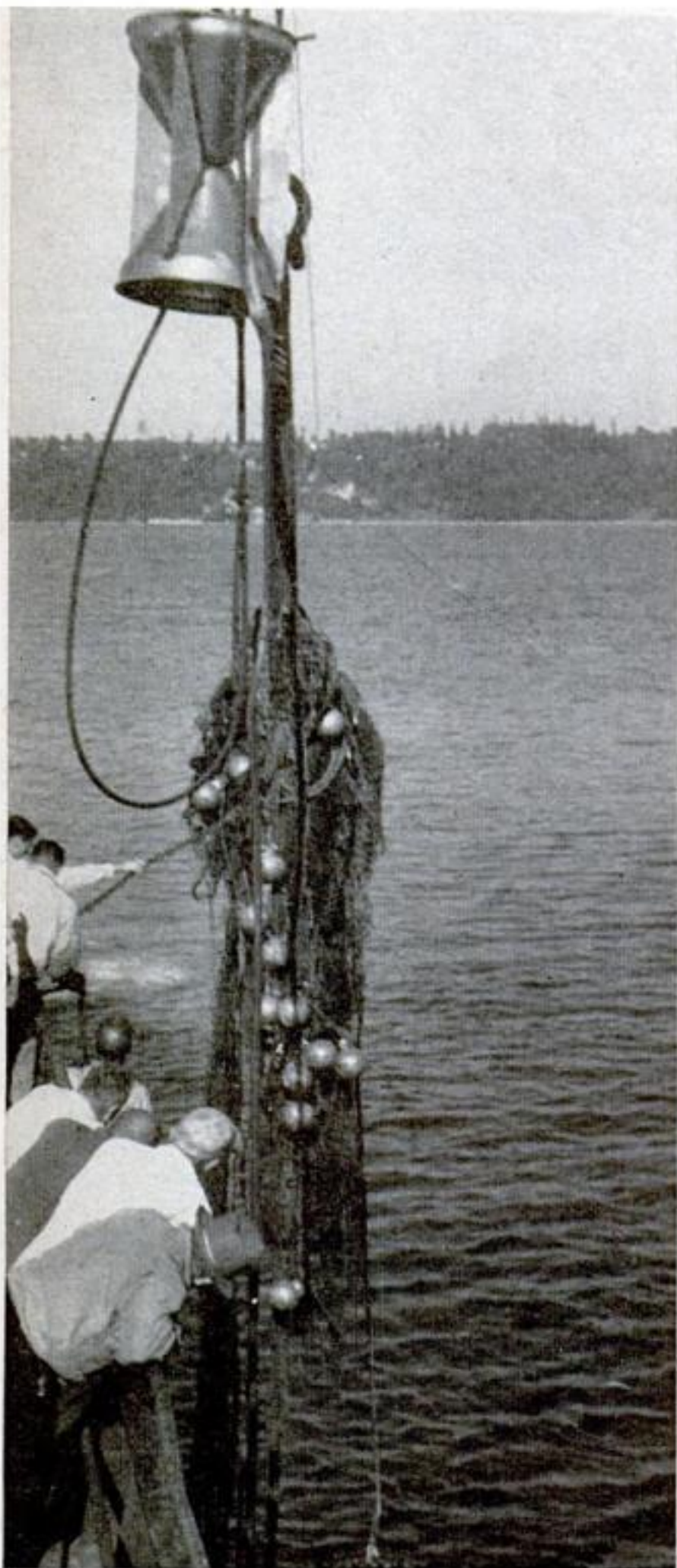


*Salvage operations begin. Tug Amak pulls away from the work vessel Salvage Chief, hauling one end of a 1,500-foot steel cable which the two ships dragged to snare and lift the Cape Douglas free from the ooze of East Passage bottom.*



## DOUBLE-LENGTH FEATURE OF TRUE SCIENCE ADVENTURE

"Without our Sea Scanar," said one man aboard the Neper that day, "the Salvage Chief would have been like a blindfolded man on top of a 10-story building trying to retrieve something from the sidewalk by lowering a long string with a wad of chewing gum on the end of it. And with a wind blowing the string, too, for there was a tide to contend with."



*Grappling hook brings up a Cape Douglas fish net. "Hourglass" device at top is reflector used as target for Neper's Sea Scanar gear.*

SO UNERRINGLY did the sonar do its job, however, that the hook landed on top of the Cape Douglas' deckhouse. On its first pass, it scooped up a fish net that had been stowed there. Tangled in the net lay the anchor that had been severed from the marker buoy.

Successive dips of the hook wrenched loose the Cape Douglas' mast and boom, and broke off fragments of the superstructure as if they had been bits of cake frosting. But the waterlogged hull failed to budge.

Capt. Devine abandoned that fruitless tactic and set out to "lasso" the drowned vessel's stern. The maneuver began, as once before, with the dragging of a 1,500-foot cable between the Salvage Chief and the Amak. This time, it firmly caught under the stern of the Cape Douglas. The Amak then brought its end of the cable over to the Salvage Chief, which extended a boom, like an outstretched hand, to take it aboard.

A 350-pound steel block then gathered the loose end of the cable to the main line, firmly held by one of the Salvage Chief's great diesel-electric winches. A kind of giant slip knot was formed.

With infinite caution, the steel noose was lowered and pulled taut around the stern of the Cape Douglas, lying in the mud 660 feet beneath the surface.

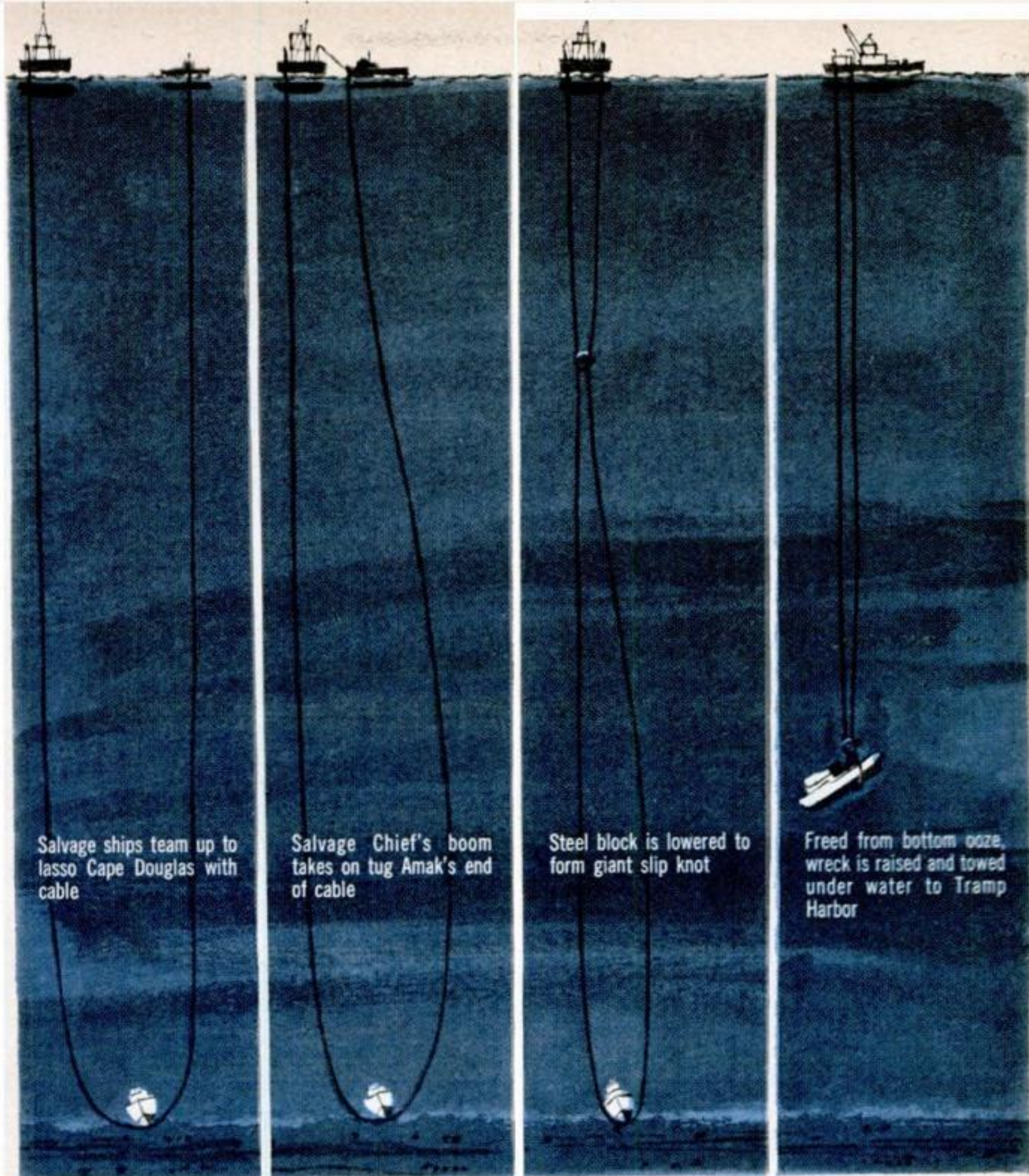
In the course of a nerve-wracking week, the sunken stern was lassoed four times. One line parted. Heavier cables and a huskier tug were summoned.

On the third day, a violent squall hit the East Passage. Wind slapped the stern of the Salvage Chief so savagely

that it couldn't hold position. Yet if it were blown away, all the lines attached by such laborious seamanship would be torn loose. Both the tug and the Neper had to throw lines to the Salvage Chief and pull into the wind with all their strength to keep the big vessel from being wrenched away.

At last, with attached cables straining, the hulk of the Cape Douglas was hauled out of its bed of muck. It was then





painstakingly dragged upward, dangling bow down, until it hung 100 feet below the surface.

Capt. Devine had decided to carry the vessel under water, hanging from the precarious wire loops, for three miles to the sandy bottom and relatively shallow water of Tramp Harbor, on Vashon Island.

On July 4th, the *Salvage Chief* made this trip, moving with the exaggerated stealth of a tiptoeing child. It took 3½ hours to go three miles. But there were no mishaps.

The *Cape Douglas* was lifted gently over the floor of Tramp Harbor and finally laid down on clean sand about 100 feet below the rippled surface.

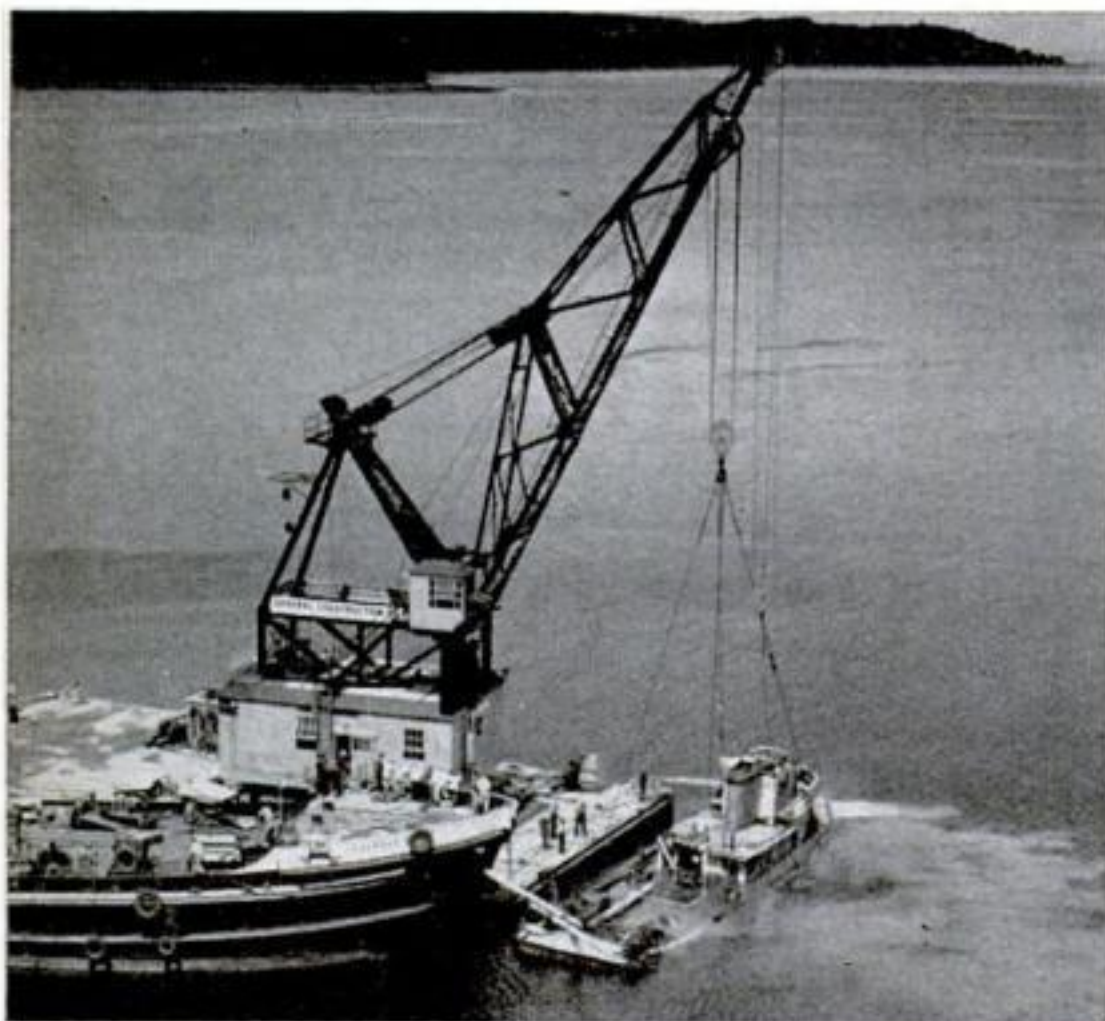
A huge electric marine crane, called in from Seattle, was waiting for her there. Capt. Devine sent down divers to remove the stern cables from the *Cape Douglas* and attach a sling of new ones, in which the crane could haul her up evenly.

*Two salvage ships team up, using cable to lasso the drowned vessel's stern. For final operation, *Salvage Chief* took on *Amak's* end of the cable, and raised the *Cape Douglas* from its bed of muck—on the fourth try.*



## DOUBLE-LENGTH FEATURE OF TRUE SCIENCE ADVENTURE

On July 7th, a 40-foot Coast Guard patrol boat churned into the harbor with investigating officers, Salvage Association officials, and FBI agents aboard. While they watched, the great crane, looming over the attendant boats like a stork



*Towed under water to Tramp Harbor, the Cape Douglas was finally brought to surface by a huge marine crane.*

among ducks, slowly hoisted the sodden Cape Douglas back to sunlight that she had left six months before. She was an 80-ton load for the crane's groaning winches.

Soon, motor pumps were trying to drain her dry. But there was a point beyond which they seemed to make no progress. When there were still a few feet of water left in the engine room, investigators went aboard.

They found no holes in the hull, but they made a more sinister discovery. The sea valves, for admitting water to the fish hold, washing down the deck, or fighting fire, were wide open! Their big control wheels, almost as large as automobile steering wheels,

had been spun loose as far as they would turn. Experts later testified that this could not have happened except by someone's deliberate action.

The sea valves were now closed, and shortly the Cape Douglas was dry once more and floating like a cork.

### III. The Trial .....

THE FBI at once began a hunt for Odd John Solnordal. He was found working as a crewman on a fishing boat off the coast of Alaska. The U. S. Government arrested him on charges of barratry. A term of maritime law, barratry is willful destruction of a vessel or its cargo by its captain.

Solnordal's trial, with a firm but kindly judge presiding, began in the U. S. Court House at Seattle on Jan. 25, 1960. It was over in six days. Prosecuting attorneys paraded the experts who had been involved in the salvage effort. In addition to their thoroughly damaging testimony, the Government sprang some dramatic surprises.

Kenneth Ness, Solnordal's sole companion aboard the Cape Douglas on the night she sank, had previously backed up Odd John's story of how it happened.

Now he gave a startlingly different story.

Ness testified that when he had rushed to tell Solnordal that the boat was sinking, the skipper had said, "Don't worry! There's three thousand dollars in it for you if you side with my story."

"I told him to go to heck, that it wasn't worth it," Ness assured the jury. Then, when he saw the ship was going anyway, Ness added, he said, "'Make it five.'" Solnordal refused.

In addition, Marvin Hamlin, a former cook on the boat, and Capt. Jack Ray, previously its skipper, both testified that Solnordal on earlier occasions had offered each of them several thousand dollars to sink the Cape Douglas for him. Both had refused. But when Ray did so, he said that Solnordal had persuaded him to point out the sea cocks.

"She had a complicated engine room in



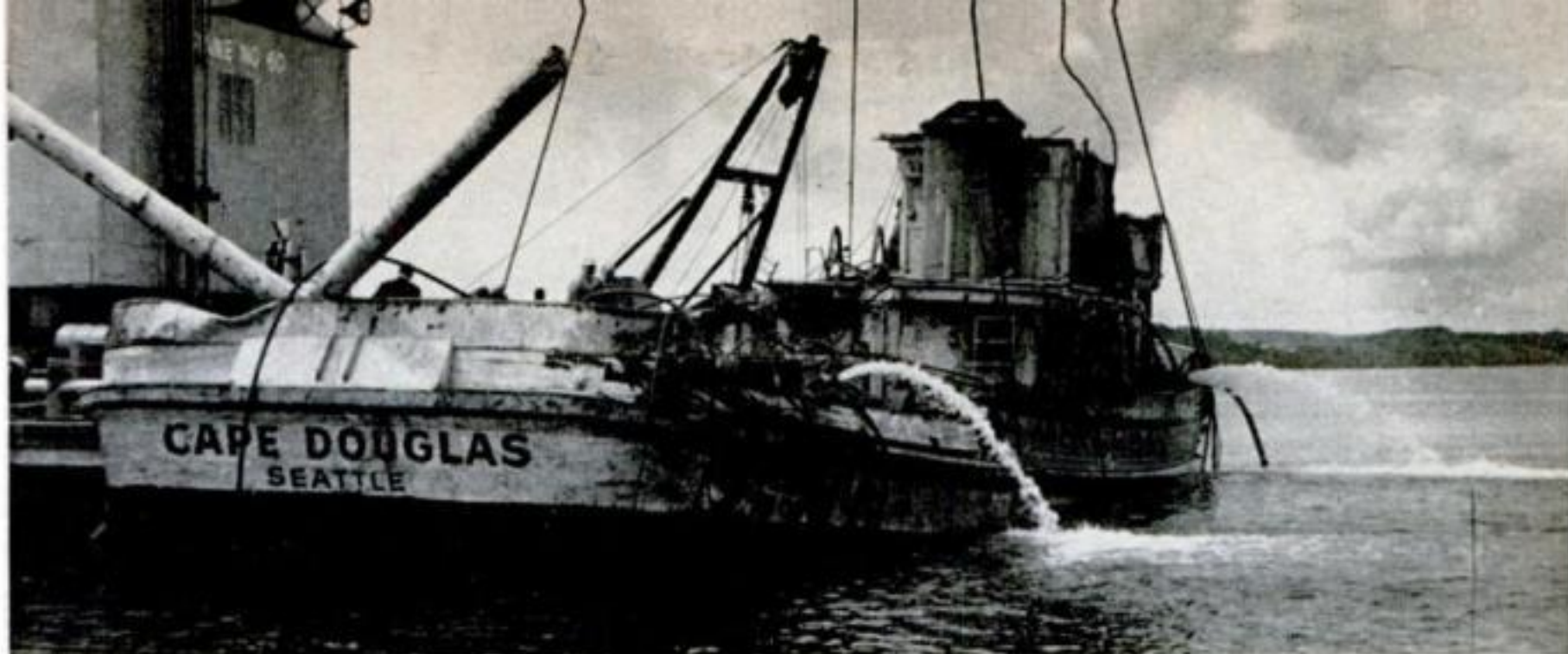
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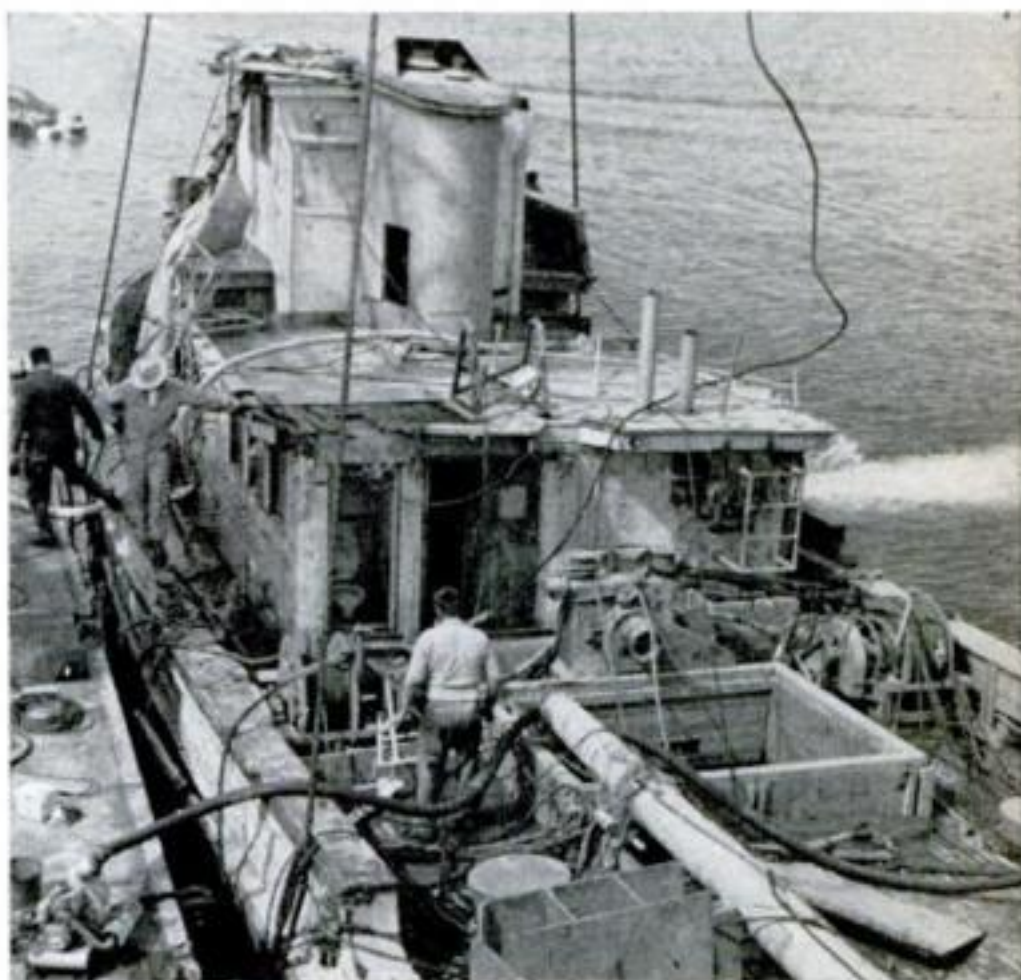




*Afloat again, Cape Douglas is pumped out as investigators wait to board her.*



*Wreck is examined. Mast, broken off by Salvage Chief's grappling hook, lies on deck of fish hold.*



*Damage to the Cape Douglas was mostly from salvage operations.*

her," Ray explained, "and apparently he didn't know how to work any of the valves or any part of the system." In the engine room, Solnordal had pulled up the floorboards so Ray could point out the sea cocks. Then, said Ray, "He went back up into the fo'c'sle and got a couple pieces of string, and I showed him which valves to tie the strings on."

On the stand, in his own turn, Solnordal shouted "No! No! No!" when asked if these men had spoken truly. His eyes were dark and wide with dismay.

But the jury took not much more than three hours to reach a verdict: guilty on all counts. Odd John Solnordal can still see the fateful waters of Puget Sound, but only through the bars of the federal penitentiary on McNeil Island. His sentence: five years and a \$3,000 fine.

Reportedly, the salvaging operations

had cost the insurance companies around \$50,000. But they were still \$30,000 better off than if they hadn't financed the effort to disprove Solnordal's claim.

And what happened to the Cape Douglas, the ship that returned from her underwater grave?

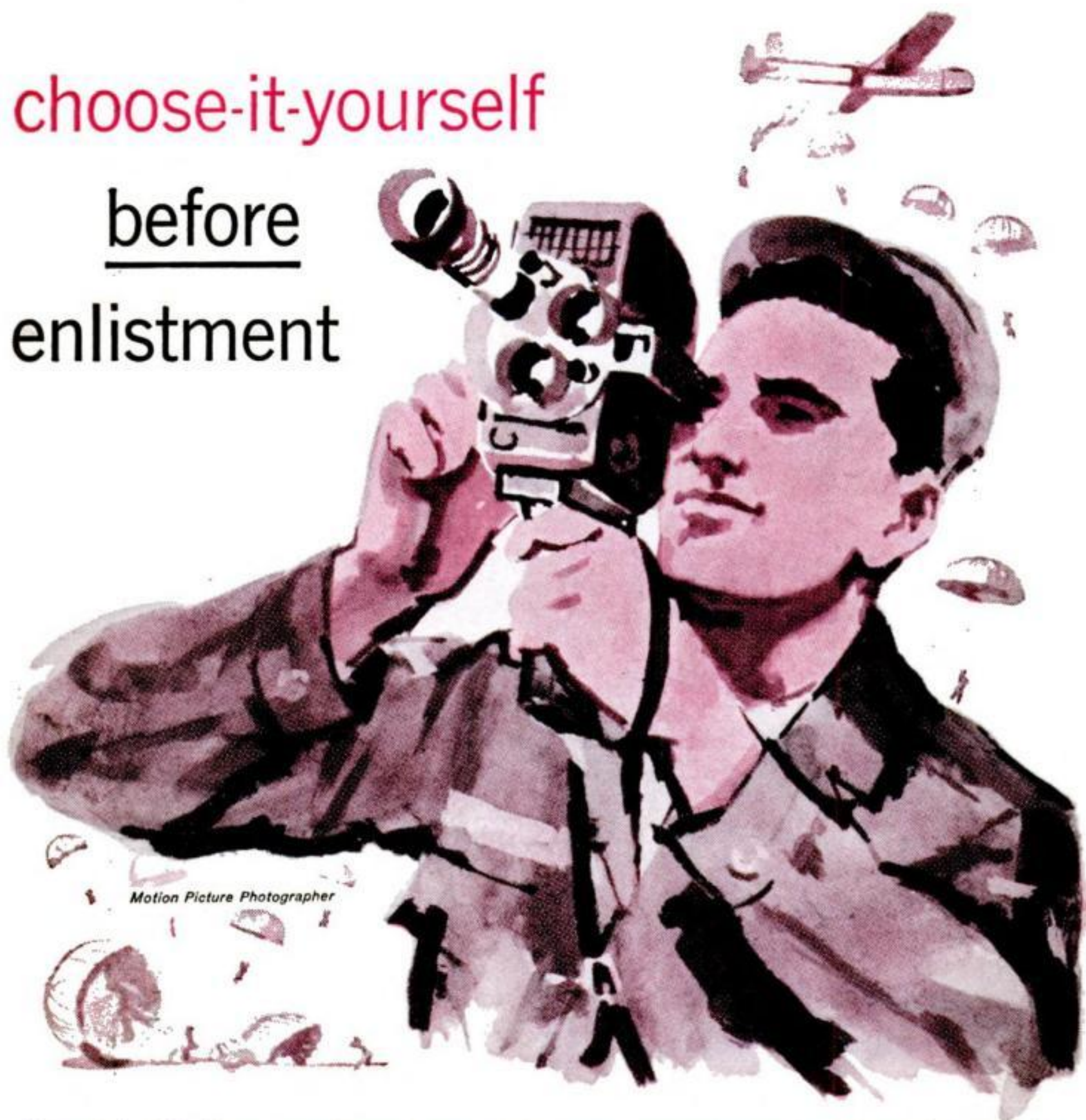
Sold at public auction to partially satisfy Odd John's creditors, she brought \$9,000. Her new owner, a Canadian, had her rusted, silted engine and auxiliaries flushed, cleaned, and set to running again. Then, last March, she journeyed to Vancouver to be refitted with gear, freshly painted, rechristened, and sent down to the seas to fish once more. Going north to her new home, she rode proudly through the East Passage, spray dancing from her bow as she passed lightly over the dark chasm that, even at 666 feet, had not been deep enough to hold her.



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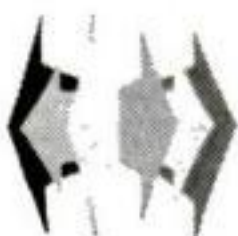
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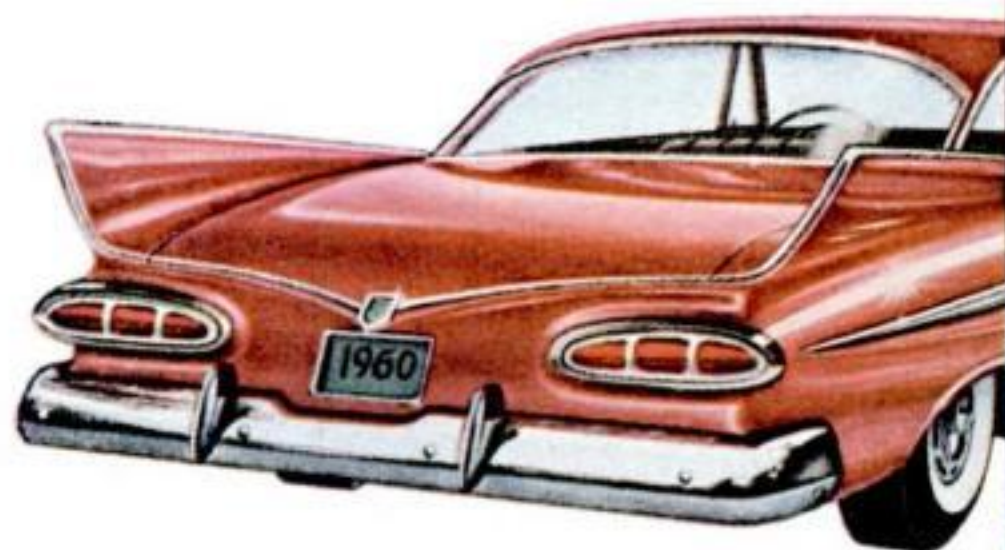
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